MODEL

AIRPLANE NEWS

TAME YOUR TAIL-DRAGGER

THE WORLD'S PREMIER R/C MODELING MAGAZINE

48120

September 1996

Learn to Scratch-Build

Tips for Getting Started

The Ultimate Tiger Moth

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features

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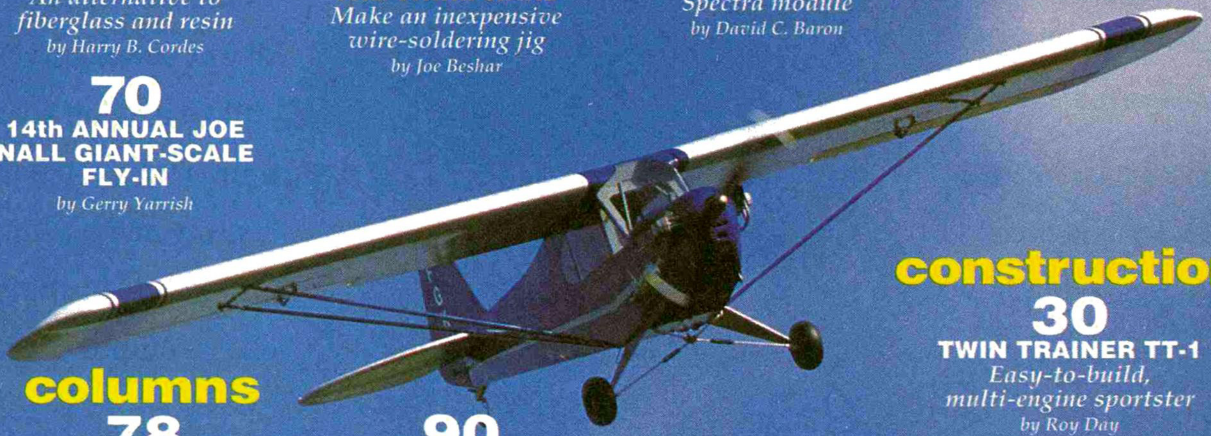

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ON THE COVER: main photo—Graeme Mears' beautiful de Havilland D.H.82A Tiger Moth (flown by Dave Patrick) won first place in Team Scale at this year's Top Gun Scale Invitational. (Photo by Walter Sidas.) For a closer look, check out this issue's "Final Approach." Inset: Jim Sandquist's Aerotech Models P-51D Mustang.

ON THIS PAGE: in an unusual scale, blue-and-white paint job, Roger Post Sr.'s Great Planes .60-size Piper J-3 Cub enjoys a leisurely flight around the airport. (Photo by Walter Sidas.)

AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News**, 251 Danbury Road, Wilton, CT 06897-3035; e-mail: man@airage.com. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we can not respond to every one.

TIGER THANK YOU

Hi, I'm 16 years old and enjoy reading "Aerobatics Made Easy" by Dave Patrick. I've always wondered what it would take to fly pattern airplanes, but I have been put off by the expense of high-performance pattern kits. One day, I picked up a back issue of your magazine and read an interesting article by Mr. Patrick on getting started in novice pattern. It was a good thing I read that because I had a Tiger 2 kit and a SuperTigre .46 on hand. I decided to build the kit for competition aerobatics. I made several mods to the airplane, including clipping 11 inches off the wings, eliminating the dihedral and installing tail-dragger gear. To keep the aerodynamics of the plane as close as possible to that of a retractable-gear plane, I'm going to use low-drag racing wheels. As I write this, I have almost finished building the plane, and I hope to test-fly it in a couple of days. With practice, I hope to be competing soon. Thanks for having great columnists like Dave Patrick. He and authors like him are what this hobby needs to keep growing.

RYAN WINSLOW
Sumner, WA

Ryan, thanks for the kind words. Good luck with your modified Tiger 2. GY

SCALE SPEED

It is good to see that *Model Airplane News* has included additional articles relating to scale modeling. I was also pleased to see Andy Lennon's article, "High-Lift Devices & Drag Reduction" in the May '96 issue. Andy mentioned the subject of scale speed and its discrepancies or contradictions. As you know, this has been a favorite subject of mine since it also concerns contradictory rules for realism ambiguously applied in many AMA contests. The U.S. Scale Masters Championship and Top Gun have both clarified or eliminated this ambiguous requirement over the last several years. The AMA Scale Contest Board is also rethinking this, particularly since a majority (54.5 percent) had voted a change was appropriate in the rules. Unfortunately, the strange consensus system in the AMA requires 60 percent approval.

Modelers like Andy who can pass on accurate information are to be congratulated. It is surprising how much erroneous information or "opinion" has still lingered from the past.

Greater insight is of value to all modelers. My compliments to your magazine for also supporting this theme and being a part of the productive side of the information superhighway.

KENT WALTERS
Scottsdale, AZ

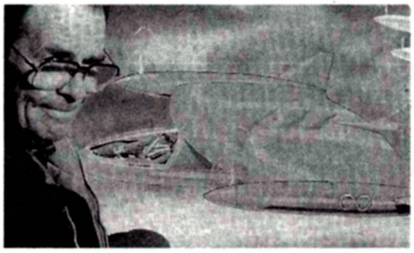
We agree that a consensus on an unambiguous definition of scale-like speed would help invigorate scale competition. Readers who would like to find out more about this surprisingly complex subject should also see the "Model Airplane News Forum" on this subject on page 59 of our September '93 issue. TA

PSEUDO-SCALE KUDOS

My compliments to Rupert Kosmala for his article in the May '96 issue concerning the creation of a pseudo-scale event, to Jerry Nelson for his thoughts on "prototype scale" and to Jim Newman for his descriptive illustrations.

Small wind-tunnel models have been used for years to investigate the characteristics of new aircraft designs, so there is no reason why a somewhat larger prototype cannot be moved from the tunnel into a true dynamic environment—six degrees of freedom, the whole works!

Hardly an aircraft configuration exists—from Reno racers to tilt-whatever VTOL/STOLs—that cannot be evaluated in sub-scale and at a fraction of the cost of a full-size aircraft. Materials, engines and R/C equipment are readily available to the modeler with a vision and a passion for invention.



I see the Zimmer'son Six (see above photo) as a vehicle that could scald the airways at Reno; it has a unique configuration that is actually a modern clone of the V-173 and XF5U-1 Flying Pancakes. In the mid-1940s, Charles Zimmerman and Chance Vought Aircraft began the development of an aircraft that promised both VTOL/STOL performance and blistering speeds.

The Tsunami and the Pond Racer brought new excitement to the Reno air races and a departure from the use of ex-military fighters, but at an unbelievable cost. Sadly, both aircraft and pilots were lost, and the economics of fielding similar racers is questionable. Neither the cost nor the risk to human life exists with sub-scale prototypes.

With Reno as a theme, it is easy to visualize an actual event that would allow real competition to take place, and one can see sponsorship being provided by [full-scale aviation] Industry. A successful model could well be scaled to permit true Reno competition. Think about it!

DICK JOHNSON
Dallas, TX

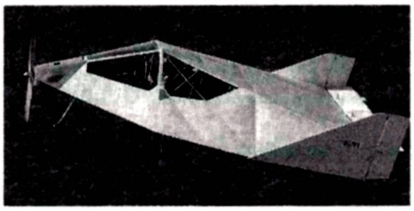


PHOTO BY FRANK MORMILLO

Dick, we agree with your logic. In fact, some full-size aircraft designs have been inspired by model designs. Barnaby Wainfan's Facetmobile FMX-4 (see above photo) was inspired by a small lifting-body, toss-glider model called "The Thing," which first appeared in the December '72 issue of American Aircraft Modeler. Some really amazing full-scale designs have benefitted from modeler R&D! GY

ADDENDUM

In the July '96 "Airwaves" column, Steve Slachta, president of Aeroloft Designs, informed us that his company is the sole U.S. provider and manufacturer of the Avonds F-15 Eagle, Rafale A and 104-F Starfighter kits. We would like to add that Jet Hangar Hobbies Inc. is the sole distributor and U.S. manufacturer of the Avonds twin-engine F-15 Eagle kit.

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EDITORIAL

by GERRY YARRISH

TAMING THE TAIL-DRAGGER

One of the most talked-about topics in R/C is which type of landing gear is better for model airplanes—tricycle landing gear or tail-draggers. If you're used to a nose wheel, then switching to a conventional tail-dragger might seem a little daunting, but it really isn't a big deal if you know what to expect and how to set up your model. In fact, a tail-dragger is sometimes better suited for flying out of and landing in small, grass fields. If you're considering this type of model, then "Tame the Tail-Dragger" by Jerry Nelson is required reading.

Pat Hartness (with microphone) talks about the Joe Nall Giant-Scale Fly-In and the trophies given each year. Pat's wife, Mary Lou, is to his left.

BIPLANES AND RIGGING WIRES

So there you are with your brand-new biplane, beautifully detailed and fully rigged with all the flying and landing wires attached, but it's too big to transport all put together. What do you do? Columnist Bob Underwood shows us how to remove and transport the wings of his Top-Gun-winning hiperbipe homebuilt without having to remove those intricate rigging wires. How's it done? See "Scale Techniques," and keep your rigging intact.

DIFFERENTIAL, BELLCRANKS & DIRECT-CONTROL SERVOS

In his continuing series of articles on control linkages, Mike McConville discusses how to achieve differential control for ailerons. Having more throw in one direction than in the other is one way to minimize adverse yaw in models. Setting up bellcranks for differential control in particular requires some forethought, because once they're installed, they become very difficult to adjust. Mike's article will help you over some of the pitfalls.

THE OSHKOSH OF R/C

One of the interests most R/C modelers share is a quest to find *the* perfect flying event or location. We often travel many hours to a favorite fun-fly or a meet for a variety of reasons: to visit with old friends and make new ones, to see the latest in model design and sometimes simply to get away and relax at a flying site that may be bigger or better than our own local pea patch. I love my local flying field and enjoy the time I spend there, but I also look forward to my yearly trips to other club fields. Each has something different to offer and, for me, this is one of the reasons why I find this hobby is so appealing.

What if you could put all the good parts of all your favorite flying events together in one location? Hartness Field in Greenville, SC, just might be that location. The Joe Nall Giant-Scale Fly-In, put on by the Confederate Air Force at Hartness Field, is a privately owned R/C haven open only to AMA members and their guests. Once you've experienced their brand of Southern hospitality, it will linger in the back of your mind, changing forever your idea of what perfect events are all about. Add to this some of the best fliers and models from across the country, and you'll be hooked. In this issue, we bring you just a small sampling of the Joe Nall Giant-Scale Fly-In; this is an event that you shouldn't miss. If Oshkosh can be considered the ultimate full-size aviation event, than the Joe Nall Giant-Scale Fly-In at Hartness Field is the Oshkosh of R/C.

TWIN TRAINER

Are you interested in a twin-engine model that's easy to build and fly? Roy Day's twin trainer has enough built-in stability so that anyone can learn the basics of twin operation. It's the perfect project before you tackle a more difficult scale twin. Build this one and get twin qualified; it's twice the fun!

Hints & KINKS

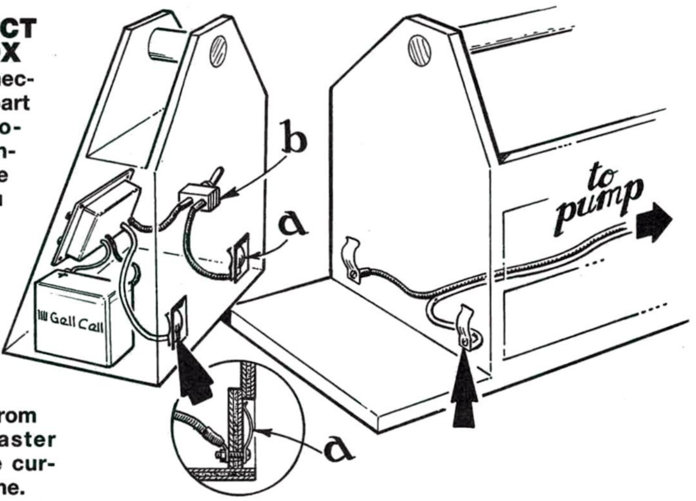
by JIM NEWMAN

Model Airplane News will give a free one-year subscription (or one-year renewal, if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.

AUTO-CONNECT STARTER BOX

Springy brass connectors on your two-part field box will automatically make contact with ones for the fuel pump when you bring the field-box halves together. This avoids having messy plugs and leads. Note how the live brass tabs (a) are recessed to prevent short circuits from occurring. A master switch (b) kills the current. Use it every time.

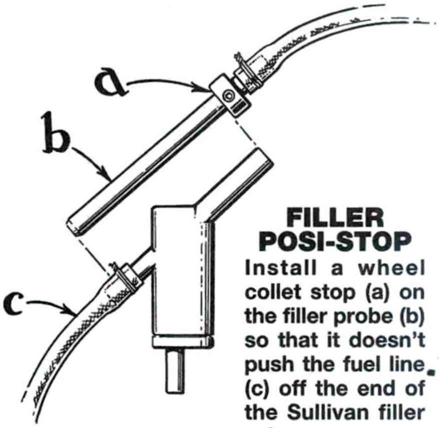
Steve Grissom, Shawnee, OK

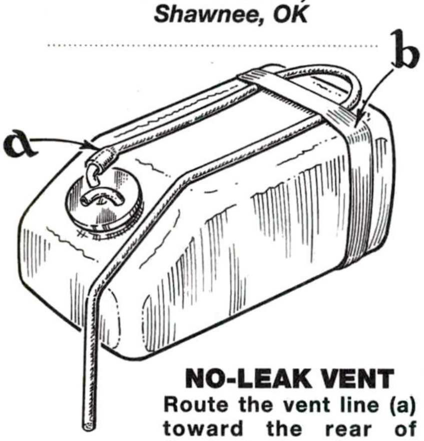


FILLER POSI-STOP

Install a wheel collet stop (a) on the filler probe (b) so that it doesn't push the fuel line (c) off the end of the Sullivan filler valve.

Levent Suberk, Bursa, Turkey





NO-LEAK VENT

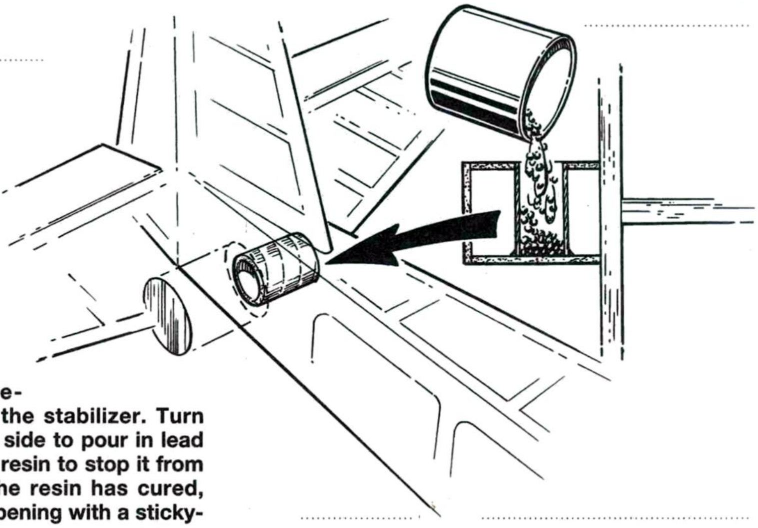
Route the vent line (a) toward the rear of the tank, then forward again, and secure it with strapping tape (b). Now, if you stand a model on its nose, fuel won't run out through the vent; fuel won't flow uphill!

Skip Evans, Rosharon, TX

TAIL BALLAST BOX

To fit a ballast box at the tail, copy the free-flight technology this modeler used. Glue a short cardboard rocket tube across the fuselage and under the stabilizer. Turn the model on its side to pour in lead shot (add a little resin to stop it from rattling). After the resin has cured, cover the tube opening with a sticky-film patch.

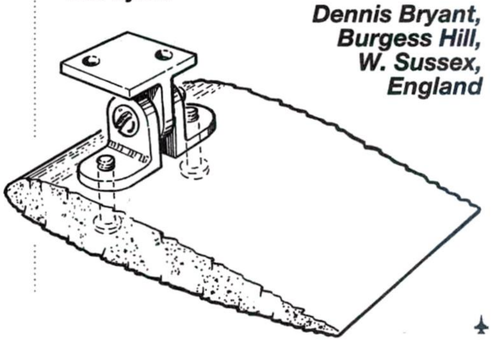
Don Giffin, Sarnia, Ont., Canada



JUNKERS FLAP HINGE

Try this simple method of installing the Junkers-type flaps now found on many homebuilt models. Use 90-degree nylon brackets and cut-down control horns from your hobby store. No need to use nuts; screws will securely self-thread into nylon.

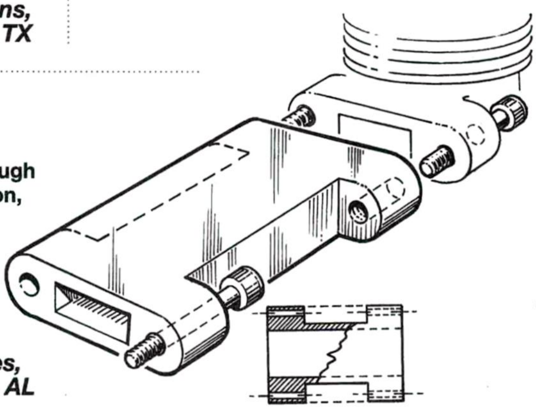
Dennis Bryant, Burgess Hill, W. Sussex, England



LONG STACK, SHORT DRILL

Unable to find a drill bit long enough to go through a muffler extension, Mark cut out its sides as shown. Now, he has only a short distance to drill (and tap where appropriate); this also eliminates hole-alignment problems.

Mark Humphries, Danville, AL



MODEL AIRPLANE NEWS
HOW TO

Tame the Tail-Dragger

Setup secrets for better takeoffs and landings

by JERRY NELSON

AIRPLANES EQUIPPED with tricycle gear are considered the easiest types to take off and land. Generally, this is true, but if you follow certain design considerations and know what to expect aerodynamically, aircraft with a tail wheel—especially the larger, heavier giant-scale models—can also be easy to take off and land.

ADVANTAGES AND DISADVANTAGES

There are many advantages to having a tailwheel.

- **Lightness.** A tailwheel assembly can be much lighter than a nose-gear unit.
- **Ease of installation.** It's easy to provide a mounting bracket for a tailwheel assembly; the unit is external and easy to service.
- **Simpler steering linkage.** Steering linkage generally consists of a couple of springs and two lengths of fine chain. The linkage is also external and easy to install and service.
- **Less drag.** Nose gear increases drag significantly; tailwheel drag is minimal.
- **Excellent rough-field performance.** A small nose wheel can get caught in the dirt or grass/weeds.
- **Easier takeoffs**—because the landing gear is in front of the center of gravity. At rest, on the ground, there is no normal nose-down attitude (commonly found on tricycle-gear aircraft). With some up-trim, the model will take off gracefully all on its own.

Now to the disadvantages.

During takeoff, rudder control can be more sensitive than with a tricycle-gear aircraft. On *some* aircraft, with very little airspeed, the tailwheel leaves the ground, thus making no contribution to steering; only the rudder, which, in this case, is not too effective at low airspeeds, is doing the job. An aircraft with tricycle gear usually has its nose on the ground longer, so it contributes to positive steering. When the nose gear lifts off, the rudder is effective because of the higher airspeed.

LANDING TECHNIQUES

The main disadvantages of having a tailwheel are encountered on landing. It is pretty hard to screw up a tricycle-gear landing of a model or a full-scale aircraft. With a tailwheel, pilots must learn certain techniques. Most tail-draggers are landed in a three-point attitude: all three wheels touch the ground at the same time, usually just at stalling speed and with full up-elevator (or low-rate full up) during the last couple of seconds. Full up-elevator is also held while decelerating to a slow taxi speed. This keeps additional weight on the tailwheel and provides more positive steering. This takes practice and requires fine adjustments of the elevator travel. Smaller models can be difficult to control; with the giant-scale types, this isn't as hard to do.

- **Crosswind takeoffs and landings** are more of a problem with a tail-dragger. At low speed, the aircraft has a tendency to weathervane into the wind; the challenge is to keep lined up with the runway. This really isn't as important as it may seem. If the wind is that strong, you can usually take off and land diagonally to reduce or eliminate the effect of the crosswind.

- **Wheel landings** with the fuselage almost level and at higher airspeeds, are usually more difficult to do. To make good wheel landings, the gear and wheels should be fairly stiff. When a model with a stiff gear touches down, it shows very little tendency to bounce. (A brick won't bounce.) If the gear is too flexible, the model bounces, then touches down, then bounces, and so on (see Figure 2). Some of these landings are really exciting, but they aren't too good for aircraft (model or full-scale). If this occurs during a landing, hit the throttle and try again.

When there's a crosswind, wheel landings are best. Sometimes, to keep the airplane going straight down the runway, you have to lower a wingtip into the direction of the crosswind. The higher airspeeds in a wheel landing initially provide more rudder control.

PROPER SETUP

How do we take the most advantage of the tailwheel and minimize the disadvantages?

Figure 1. Landing-gear placement

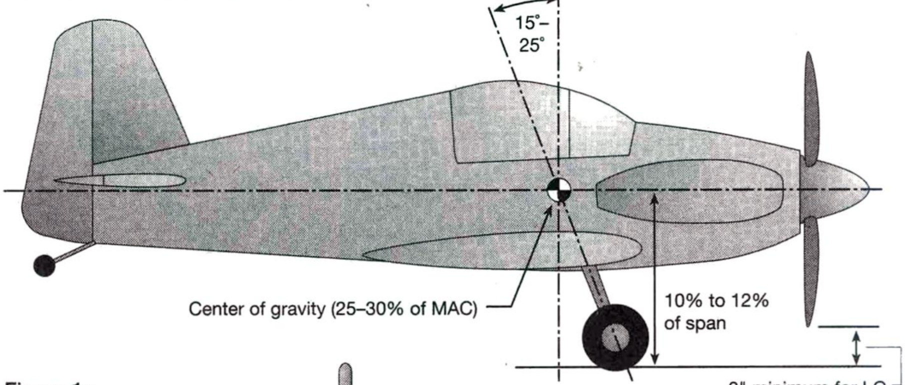
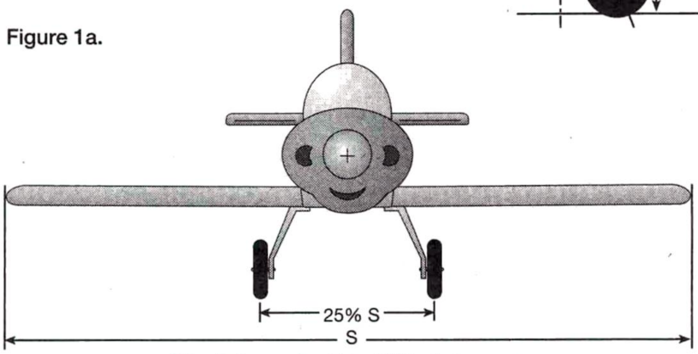


Figure 1a.



Wheel stance should be 25% of wingspan

Modelers always find tail draggers like this Super Cub appealing, but many are apprehensive about switching from tricycle gear to a tailwheel. Understanding some areodynamics and setup basics can make it easy to switch.

Start with the engine installation. There should be $1\frac{1}{2}$ to 2 degrees of right thrust. This will generally allow takeoff without rudder control—more or less hands-off takeoffs.

Next, consider the location of the main landing gear in relation to the CG. The wheel axle should be 15 to 20 degrees in front of the CG at the mean aerodynamic chord (MAC)—see Figure 1. The vertical CG of the fuselage is also relevant. Placing the MAC on the fuselage centerline is usually a good approximation of the proper MAC location.

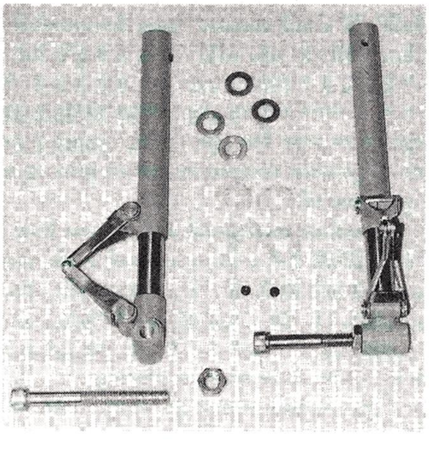
Having the gear too far forward makes the aircraft difficult to steer on the ground, especially on takeoff. The model will tend to bounce easily. But for rough-field use, the landing gear can be farther forward from the CG than usual to prevent the aircraft from nosing-over. Having the gear too far back makes for better steering on takeoff; the rudder is very responsive because the landing gear is close to the CG, but the aircraft will nose-over easily. The 15 to 20 degrees is practical and works well on most model aircraft.

For many conventional models, it's good to have the front of the landing-gear wheels in line with the wing leading edge. This works well, unless you have an airfoil that is unusually wide (see Figure 1).

The landing-gear struts should be as short as they can be. Two concerns determine strut length:

• Minimum prop clearance needed. With the fuselage level, a giant-scale model should have at least 2 inches of prop clearance, considering the largest propeller to be used. If you fly off a rough field, you'll need more clearance to protect those $20 props.

• Angle of attack at the moment of touchdown. If the gear is too short, the tailwheel will hit the ground too soon. Gear of the proper length will allow all three wheels to touch the ground when the model stalls and touches the ground.



Robart makes custom shock-absorbing main gear in many sizes. Shock-absorbing Oleo struts greatly improve tail-dragger ground handling.

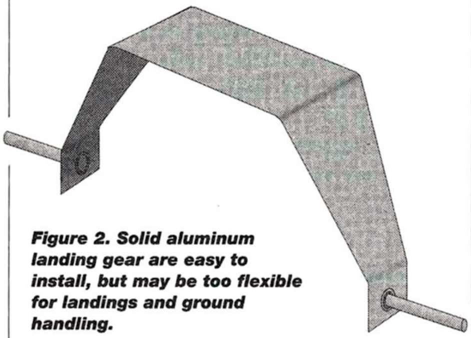


Figure 2. Solid aluminum landing gear are easy to install, but may be too flexible for landings and ground handling.

The distance from the wheels to the fuselage centerline should be 10 to 12 percent of the wingspan; the total distance between the wheels should be about 25 percent of the wingspan. If the wheels are too close to the fuselage, it is easy to scrape the bottom of the wingtips. If the gear is too wide, you'll have to contend with some structural problems in the wing-spar design. The 25 percent figure is a good compromise (Figure 1a).

The landing-gear struts should be as rigid as possible. Some vertical strut motion is, however, desirable to avoid damaging the attachment structure and to reduce the stress on the airframe. You need shock springs that provide a limited vertical shock-absorbing action such as those made by Robart*; they have functional shock struts.

If, on an all-aluminum gear, the legs are long, they can be extremely flexible; you might scrape the bottoms of the wingtips on cross-wind, one-wing-low landings. A spreader bar between the axles, up to the bottom center of the fuselage (attached to the fuselage directly or to bungee-cord system) rids the aluminum gear of flexibility and keeps the weight down (Figure 2a). The spreader bar must be very strong, because the loading on the unit during a bad landing can be high. My prototype AL-1 aluminum landing-gear legs are too far apart. There is too much spring in the landing gear to make wheel landings, but three-point landings are fine. If the gear was stiffer, its weight would be excessive.

Give serious thought to how you attach the landing-gear system—especially the landing-gear struts. You might think the main stress on the attachment points would be the landing itself, but this isn't necessarily so. Taxiing loads are some of the main loads to be considered. When the aircraft is landing, the wing supports the weight of the aircraft; when taxiing, the wing is not supporting any of the weight; the weight is distributed between the landing-gear-strut attachment brackets. Taxiing over rough ground can really stress the structure.

The size of the main wheels is also important. To minimize drag and weight,

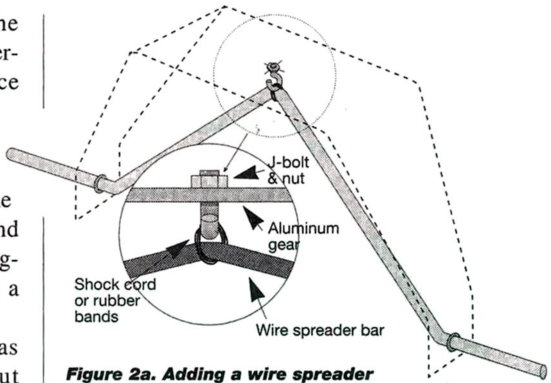


Figure 2a. Adding a wire spreader bar to aluminum gear will stiffen the gear and improve handling.

the wheels should be as small as possible, but they must be big enough to cope with rough dirt, grass, etc. During takeoff, a small wheel rotates faster, and that can cause axle-bearing problems. Axles must always be well-greased—not just oiled. If you use wheel pants, the wheels *must not*

rub against the wheel pants on landing (shown by marks inside the pants).

The wheels should be of the low-bounce type, such as the light C.B. Enterprises* solid rubber-like wheels. On my AL-1, I used 4-inch C.B. wheels with a ¼-inch C.B. aluminum-gear axle assembly.

THE TAILWHEEL

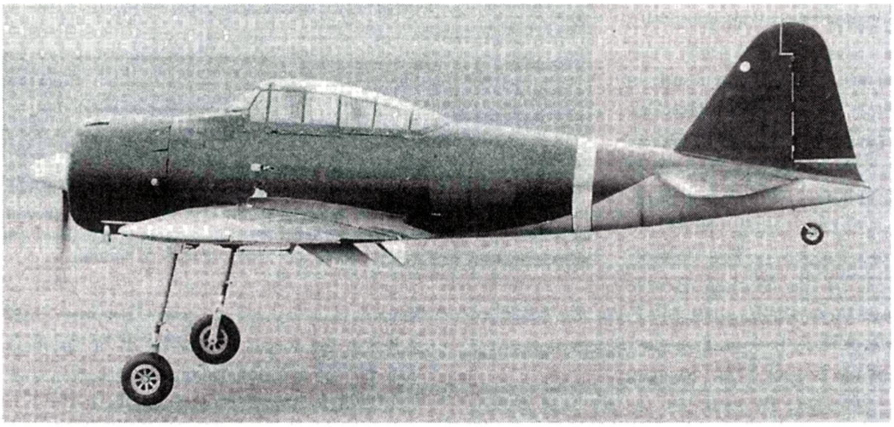
The tailwheel unit's position is determined by the aircraft's design, but it will usually be right at the end of the fuselage. The best type of tailwheel is the multiple-spring-leaf type, and C.B. Enterprises was the first to offer these to modelers—in several sizes—but other manufacturers make similar units.

Select the smallest unit that will do the job. If you have a ¼-scale airplane, you don't need to use a ¼-scale tailwheel assembly because the airplane can be anything between a tiny, 10-pound homebuilt and a 55-pound AT-6 Texan.

Use a tailwheel assembly that will flex just a little when the model is sitting on the ground. On a 30-pound airplane, the tailwheel movement from loaded (at rest) to unloaded (tail in the air) should be about ⅛ inch to ¼ inch. If you raise the model's tail assembly and then drop it, the leaf springs should flex enough to absorb the shock but should not allow the tail-wheel assembly to hit any of the tail-group structure.

The leaf springs don't all have to be used. On my 30-pound AL-1, I used the C.B. ¼-scale unit with only two of the leaf springs. If I raise the tail and let it drop, the tailwheel will bounce four or five times.

Commercially available leaf springs are generally bent too far for my liking. The leaf-spring assembly should be about 20 to 25 degrees to the fuselage centerline. You can modify the leaf springs in a vise. Bend the axle/strut assembly to follow the general contour of the leaf springs (see Figure 3).



For large warbirds such as this Japanese Zero, a wheel landing is preferred to a 3-point stall landing, especially if there's a crosswind. If the main gear has been properly set up in relation to the MAC, the model will be easier to take off and land.

Having the strut/axle assembly bent back 20 to 25 degrees has several advantages:

- The unit will have a tendency to center, or track, straight.
- There will be fewer ground-handling problems.
- The piano-wire strut/axle will also provide additional flexibility.

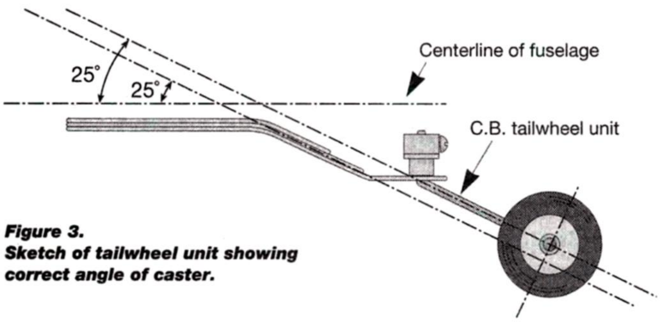
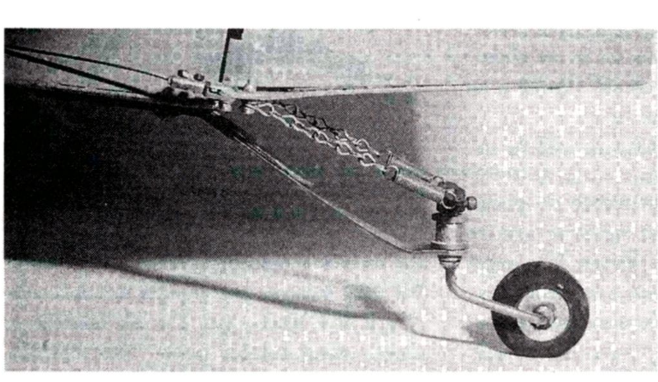


Figure 3.
Sketch of tailwheel unit showing correct angle of caster.

The tailwheel is moved by the same two control horns—one on each side of the rudder—as are used for the rudder pushrod or pull/pull cables. A linkage goes from the rudder control horn to the tailwheel steering arm. The linkage usually consists of two small springs connected with wire or, better yet, fine chain, which is available at most hardware stores, is practical and "looks" right (eyeglass chains are suitable, too).



Tailwheel units are available from many sources and are easier to install and maintain than nose-wheel setups. They weigh less and create less drag.

On the ground, very little spring tension is required to steer the model; in fact, the tailwheel can remain stationary while the rudder is easily moved from right to left.

The highly flexible springs are also required to avoid damaging the rudder servo while starting the engine. As the fuselage is moved around while the engine is being started, a lot of vibration can be sent back to the tailwheel steering system. Flexibility also helps to reduce the sensitivity of tailwheel steering as the model changes speed during takeoffs and landings. The higher the ground speed, the less the tailwheel will move—exactly what you want.

To prevent the tailwheel steering arm from coming loose, file or grind a flat spot in the strut/axle wire assembly where the steering-arm holding screw touches the wire. Grease the tailwheel bearing area from time to time.

Du-Bro* makes a series of excellent scale-like tailwheels. I use the smallest that will do the job—less weight and drag, and lighter, too. On my AL-1, I used a 1-inch-diameter wheel. I suggest that you glue the tire to the wheel hub with contact cement to avoid having a tire come off.

A perfect, three-point, tail-dragger landing is great and gives a sense of pride and accomplishment. If you were inside that airplane, at the point of touchdown, you would say, "I *think* we are on the ground now." That is the *ultimate* landing.

I give special thanks to Darryl Usher of Portland, OR, for his invaluable help in the preparation of this article.

*Addresses are listed alphabetically in the Index of Manufacturers on page 110.

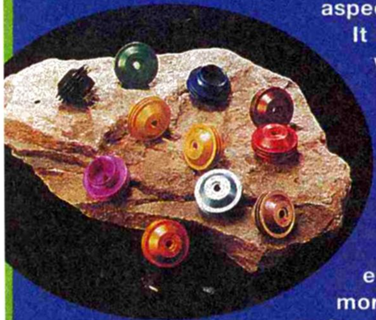
*Air*SCOOP

by CHRIS CHIANELLI

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

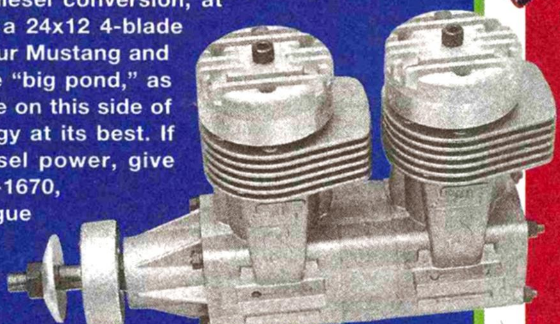
Diesel On the Rocks?

On the contrary: diesel has grown quite a bit in the recent past. The growth, in part, is due to the continuing efforts of Bob and Drew Davis of Davis Model Products. Davis makes conversions for over 100 engines produced by 18 different manufacturers covering all aspects of R/C from ducted fans to giant scale.



It appears Bob has become a bit obsessive with his anodizer! These little fellows are his diesel conversion heads for Cox's ½A .049/.050 engines. Previously available only in red and gold, Bob has now added purple and green. Just the other day, Bob informed me these conversion heads were first patented and introduced in June of '75 and have been in production ever since. Sorry, Bob; I will keep myself more updated in the future.

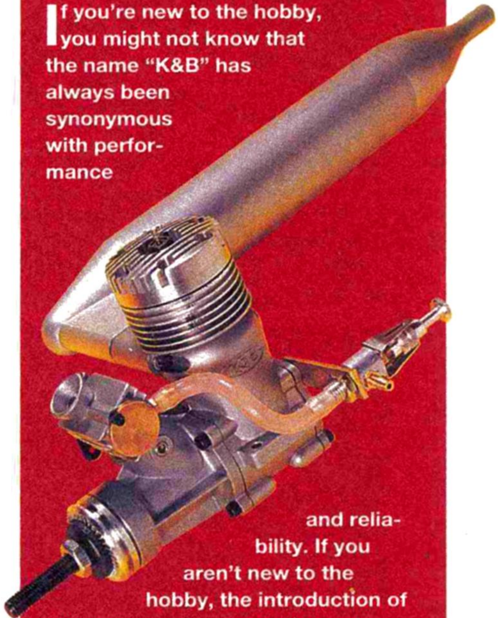
Some interesting facts. The TD .049 turns a 7x3 prop at over 14,000rpm and runs for 12 minutes on 1 ounce of diesel fuel! How's that for "mileage"? At the other end of the spectrum is a SuperTigre twin diesel conversion, at 3.6ci displacement, which turns a 24x12 4-blade prop at over 6,000. Put that in your Mustang and smoke-um! No need to cross the "big pond," as it were; the expertise is right here on this side of the Atlantic—American technology at its best. If you've been contemplating diesel power, give Bob or Drew a call at (203) 877-1670, or send for their 16-page catalogue for $5 (it will be credited against your first order). Davis Model Products, P.O. Box 141, Milford, CT 06460; (203) 877-1670.



EURO-TOW

Probably the most popular European glider towplane of all, this unique model by Frisch Wigla is a ¼-scale version of the PZL 104. This kit features an epoxy/glass fuselage and cowl, obechi-covered wings (with all the cutouts for the servos), flaps, ailerons, rudder and elevator. The 109-inch-span model has scale landing gear and is suitable for large gas motors like the Zenoah G62. For more information, contact Sailplanes Unlimited Ltd., 63 E. 82nd St., New York, NY 10028; (212) 879-1634; fax (212) 535-5295.

K&B .40 ABC



If you're new to the hobby, you might not know that the name "K&B" has always been synonymous with performance and reliability. If you aren't new to the hobby, the introduction of this new engine should be a pleasant surprise. This new .40 is, in a way, the best of both worlds—an engine whose basic design has stood the test of time and has many modern improvements.

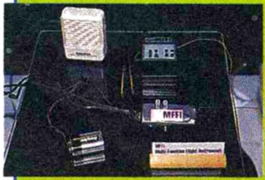
Some of those updates are: true ABC piston and sleeve technology; three, oil-retaining grooves machined in the piston; remote needle valve positioned to make it much safer to adjust the high-speed needle; and tuned-muffler system. All-time favorite features of the K&B .40, like replaceable safety prop shaft and twin-ball-bearing-supported crankshaft are all retained in this new version. Our very own "Real Performance Measurement" columnist, grand master Gierke, will do an in-depth study of the machine in the near future. Until then, for more information, contact K&B Mfg. Inc., 2100 College Dr., Lake Havasu City, AZ 86403. Customer service—7 a.m. to noon and 12:30 p.m. to 3:30 p.m. MST; (520) 453-3579; fax (520) 453-3559.

Global Tornado Carrier Certified

As of April 10, 1996, Global Hobby Distributors is seeking United States Marine Corps endorsement of all their models...well, not exactly. Actually, Hobby Shack, the retail division of Global, was running an R/C car race on the USS *Boxer* during its time in the Long Beach shipyard. Between race heats, everyone—including 1,200 sailors and 300 shipyard workers—took time out to watch Mike Greenshields put on a flight demo with Global's all-new Tornado 40 ARF powered by a Magnum .46. Because of the crowd, equipment and "steel-beach" barbecue that was going on topside, the runway was a mere 200 feet by 25 feet. Mike had a "mission-impossible" of sorts to tackle. To abort the mission, Mike had only one way to go: to his right; more specifically—overboard! I'm happy to say the mission was a success and the demo was a showstopper. The Boxer is a fairly new class of assault carrier that delivers a potent Marine punch in the form of Harriers and helicopters topside, plus hovercraft and various other amphibious vehicles out of the transom. Acting as DSO (deck signal officer) is Rick Pike and performing AO (arresting officer) duty is Mike's Dad, John Greenshields. Reports have it that every sailor on board was excited about R/C after this event. To all the guys at Global/Hobby Shack, I'd like to say a "PR" job well done!

MFFI-Link

The Advanced Avionics Multi-Function Flight-Link (MFFI) uses a transmitter in the model to send flight-critical information to a receiver on the ground. The MFFI uses temperature-compensated barometric and pito/static tube sensors to detect altitude and airspeed. Flight-pack Ni-Cds are monitored using an on-board adaptive RISC micro-processor. Engine rpm are monitored using a photo detector. The MFFI pager-size super-heterodyne receiver outputs high-quality speech into a set of headphones. A keypad allows the selection of various modes, depending on the pilot's preference. The MFFI warns the pilot if the airspeed drops below the adjustable stall speed. Also available is the MFFI Link software, which works with the MFFI system to provide a data storage method on a PC with an airplane instrument display. The display gauges include: airspeed, altitude, engine rpm, rate of climb, head temperature, exhaust temperature, stopwatch and battery indicator. For more information, contact Advanced Avionics Inc., Ann Arbor, MI 48105; phone/fax (313) 332-0256.

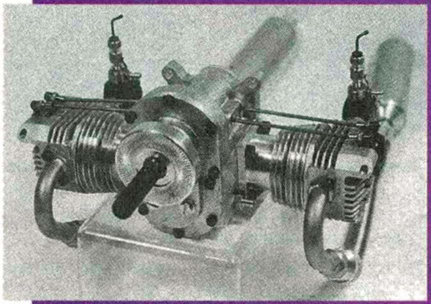


Extra-300L

Just like its full-scale namesake, the new House of Balsa Extra 300L should take the R/C aerobatics world by storm. The full-scale Extra 300L is the latest creation of Walter Extra of Germany. The 300L is a two-seat, slightly lower wing version of the 300S made famous by Patty Wagstaff and Phil Night. The 56-inch-span, balsa and plywood kit was designed for .40 to .50 2-stroke or .50 to .60 4-stroke engines and has an estimated wing loading of 21 ounces per square foot. Features include: full-size rolled plans, photo-illustrated instructions, full set of decals, scale documentation, full Du-Bro hardware pack, 1-ounce bottle of Zap-A-Gap and pre-bent aluminum landing gear. For more info, contact House of Balsa Inc., 10101 Yucca Rd., Adelanto, CA 92301; (619) 248-6462; fax (619) 246-8769; E-mail HOBANDZAP@aol.com.

BOMO B20DPT

The "DPT" stands for "Double Power Technology." According to its manufacturer, with its 2-to-1 gear-reduction drive, the B20DPT 1.20 4-stroke flat twin can turn a 20x10 prop at 5,000rpm and produce 12.6 pounds of thrust. The prop is actually driven off the camshaft, and the engine is within its optimum torque band when propped for 4,000 to 5,000rpm. This engine definitely seems to capitalize on the fact that larger props are more efficient. The 46-ounce German-made engine comes with a complete Swiss-made muffler system (with flex tubes), a tool set and a rubber-isolated engine mount. Its manufacturer is looking for a U.S. distributor. For more information, contact Bomo Hanspeter Bolanz, Flugmotoren GmbH, Albert-Lehmann-Strasse 12, 79576 Weil am Rhein, Germany; (+49) 76 21 / 6 40 58; fax (+49) 7621 66 96 43.



Simple PROGRAMMING

by DAVID C. BARON

PRISM 7X WITH SPECTRA MODULE

THIS MONTH, I'm pleased to tell you about an intriguing new concept for our hobby. We all know that the folks at Hitec* offer great radios, aftermarket servos and receivers. Now they have capped these achievements with a transmitter.

Most modelers tell me that they buy new radios for their features. Usually, there was nothing wrong with their old radios; they just weren't up to the tasks required for the latest projects. As a result, some modelers buy a new radio almost every time they acquire a new plane. Hitec realized that many radios had been retired or replaced prematurely because they didn't possess modern, programmable features.

To correct this lack, Hitec has introduced the Prism 7X transmitter—an upgrade of its well-respected Prism 7. The 7X has two features that place it a step ahead of other radios:

• It's available with a synthesized Spectra module that can transmit on any of the 50 channels.

• It can transmit to any Futaba*, JR*, Airtronics* and Hitec FM receiver! This is the biggest step taken by a radio manufacturer in years.

Now any FM system that you might have retired early because it didn't have the features that you wanted may be brought out of retirement (at least the airborne part). If you have a collection of radios at home, the Prism 7X would be one of the all-time smart hobby purchases that you could make. Whether you buy it as a system or as a transmitter only, its price is right.

The Spectra module. On its right side are the two sets of numbers and dials that you will change to match the channel that you need. As shown in this picture, the bottom dial sets the first number of the channel and the top dial sets the second one. Use a small screwdriver to reset the numbers.

When you set the 7X for the correct shift change, all the PCM and FM receivers that you have accumulated during your R/C career will spring to life. It's also great for identifying problems with radios. For example, if you have a system that has a poor range, set your Prism 7X's module for the same channel; then set the shift to the correct setting and compare the results. If the range is good, send the other transmitter back for service; if the range is limited, send the receiver! You can also use this method to diagnose problems with non-functioning radio systems; you'll easily discover which component is at fault. (If you plan to use a system other than a Futaba or a Hitec, you will have to adjust the order in which you plug your servos into your receiver: channel 1—aileron, channel 2—elevator, channel 3—throttle, channel 4—rudder.)

The Prism 7X is the same transmitter as the Prism 7 with the addition of the Spectra module and shift change.

The mixing capabilities of the Prism 7X are just as complete as that of the Prism 7. It offers built-in mixing of V-tail, elevons, flaperons, elevator/flap (coupled U-control style) and spoiler/landing configuration mixing and aileron/rudder mixing. The rest of the function list offers the basic ATVs, reversing, dual rates, trim memory, trainer functions, etc.; little is missing. My biggest complaint is the lack of "free" or "open" mixing of any channels. It would be great to have at least two. To its credit, the Prism 7X does have three-model memory; that's about as many planes as you can get to the field in one trip!

SPECIFICATIONS

Radio: Prism 7X with Spectra

Manufacturer: Hitec

Type: aircraft

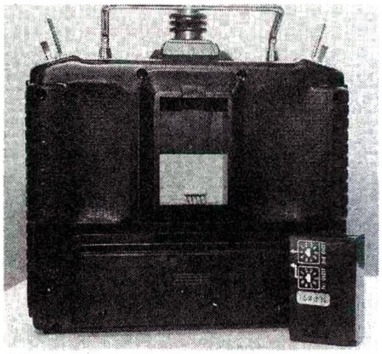
Price: $339.99 (FM); $369.99 (PCM)

Features: the Spectra module allows this transmitter to be tuned to any channel, and it will work with Futaba, Airtronics, JR and Hitec receivers.

Comments: for what this transmitter can do, at the price at which it's offered, it's a deal that can't be beat.

Hits
- The radio has a fantastic new feature that offers the ability to change the shift mode of the encoder from positive to negative. This, coupled with the synthesized frequency module, is a breakthrough for our hobby.
- Great price, great value.

Misses
- The radio lacks "open" or "free" mixes that would allow you to custom-mix any two channels.
- The display is small and uses characters that can be awkward to interpret.



The back of the Prism 7X transmitter, showing the location of the Spectra module. When you insert the module, be careful not to bend the connecting pins in the transmitter.

Addresses are listed alphabetically in the Index of Manufacturers on page 110.

MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

AEROTECH MODELS

P-51D MUSTANG

The ultimate heavy-metal warbird

by *JIM SANDQUIST*

PUT 20 WW II aviation buffs in a room and ask them which airplane had the most impact on the War, and they'll take only a few minutes to agree on the P-51. The P-51D is generally accepted as the definitive Mustang. Some 9,603 were built, and the last one rolled off the Dallas assembly line in 1945. Fifty years later, they are once again rolling off the line—in Minneapolis, MN, as models.

Wayne Siewert of Aerotech Models* created this strong, lightweight, 1/5-scale rendition out of carbon fiber. He spent a great deal of time researching the Mustang, making templates from full-size P-51s and going over drawings to create the most accurate reproduction possible.

THE KIT

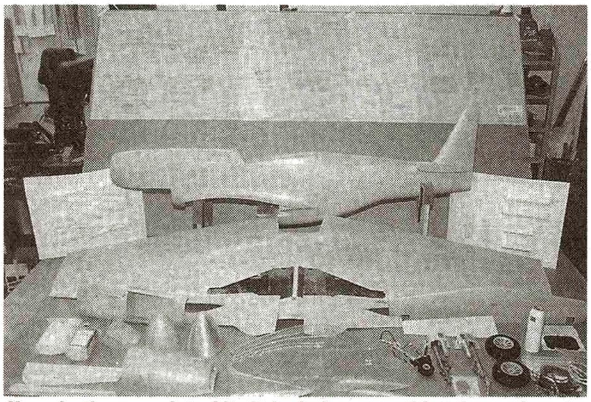
The fuselage and wing are one piece and come with all panel lines, Duz fasteners, screws and more than 20,000 rivets molded into the airframe! All hardware, retractable landing gear, wheels, fuel tanks, the fuel filler valve, etc., are included; you need to buy only an engine, muffler, glue, radio and paint.

The 12-page, illustrated instruction manual is clear and straightforward, and many instructions are printed on the three

Jim's backup competition model "Big Beautiful Doll" comes in for a landing at the 1996 Top Gun Scale Invitational.

A beautiful ground shot of Jim's competition model "Six Shooter," which scored a 96.25 in static competition.

pages of 24x36-inch plans (full-size plans are not needed because the fuselage and wings come as one-piece units).



Here is the complete kit. It includes everything from plans to wheels.

ASSEMBLY

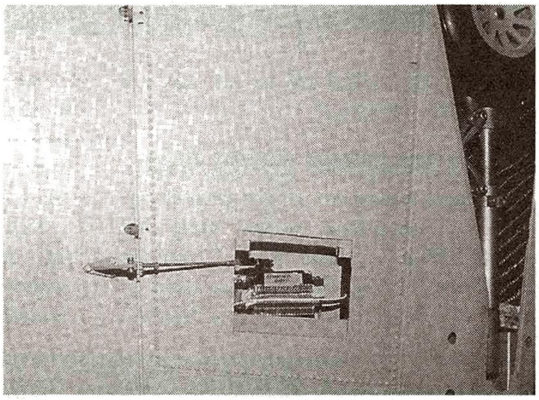
The most exotic tools you'll need are a Zona* saw, hacksaw and Dremel* tool. The carbon-fiber edges are almost needle-like, and although the manufacturer has eliminated most sharp edges, you can anticipate a few slivers. Be sure to wear a dust mask when you sand because carbon-fiber dust is extremely fine.

Begin construction by building a stand for the fuselage. The stand's shape and dimensions are on the plans. I can't stress how important the stand is in building the aircraft, and it also works well for transportation to and from the airfield.

First, cut out the area in the fuselage for the horizontal stabilizer, and cut out the gear doors for the tail-wheel assembly. This is best done with a Dremel tool and Zona saw. Then build up the rudder, and shape the elevator using the supplied balsa blocks. These will eventually have to be covered, fiberglassed and detailed to match the rest of the tail section.

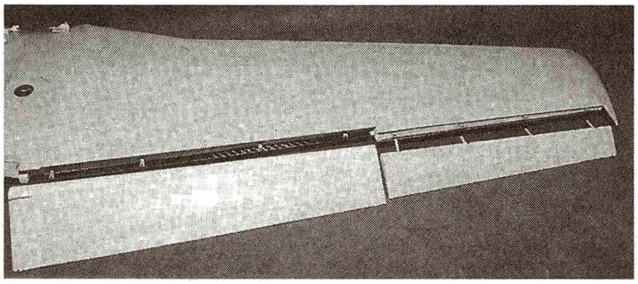
The one-piece wing is attached to the fuselage in a unique way: the trailing edge of the wing slides between the oil-cooler scoop and the fuselage to lock it into place in the back, and two hold-down bolts that are accessible through the wheel wells hold it down in the front. After this has been assembled, distinguishing where the wing ends and the fuselage begins is difficult, and all panel lines match up exactly!

The next step is to cut away the aileron and flaps from the wing with a Zona saw. After the cuts have been made and you have separated them from the wing, you will find that all the Robart ¼-scale hinges and hinge pockets are already in place. All you need to do is drill the small holes in the bottom of the wing to give you access to the hinge pocket setscrew.



Cut out the areas marked in the wing for the flap and aileron servo bay, and you will find that all the plywood servo mounts have been installed.

Installation of the supplied Century Jet Models landing gear is also very simple. The gear is made of ⅝-inch aluminum, and the ½-inch springs are more than stiff enough to handle this 25-pound model. The fork and scissor sections have been built to look like the gear of the full-size P-51. The retract system will safely hold up to 110psi and operate down to approximately 60psi. The P-51 requires a lot of air because it drives the main gear, tailwheel and the sequencing of the inner gear doors. Aluminum plates for the landing gear are already in place and attached to the leading edge and the one-piece aluminum spar. Because of the way the plate is mounted, the load is spread over the length of the wing spar, not just a couple of plywood ribs. All that is required for gear installation is to drill the four holes in each plate for the landing gear to bolt onto.



Using a Zona saw, cut away the ailerons and flaps. Pull them away from the wing, and you will find that all the hinges have been installed.

SPECIFICATIONS

Model: North American P-51D Mustang

Type: ⅕ scale

Manufacturer: Aerotech Models

Wingspan: 84 in.

Wing area: 1,222 sq. in.

Weight: 25 lb.

Wing loading: 32.7 oz./sq. ft.

Airfoil type: laminar flow

Length: 75 in.

Engine used: Moki 1.8 with pipe

Prop used: Zinger* 18x8

Radio req'd: 6-channel

Radio used: Futaba 7UAP Super

Options available: Moki 1.8 with back-plate mount ($329), pipe assembly ($166), bombs ($38 pair), drop tanks ($30 pair), static propeller and spinner ($95), Servo Slow ($34.95), Hayes whip antenna ($8), demonstration videotape ($12.50), scale cockpit kit ($75), scale options package ($65), sliding canopy frame ($95).

List price: $1,995

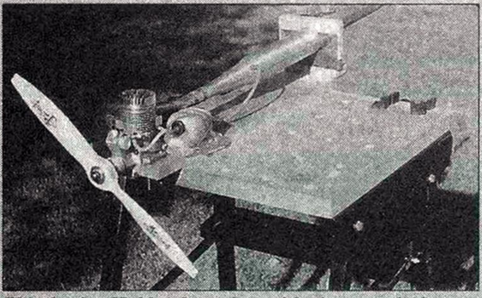
Features: carbon-fiber kit; one-piece fuselage and wing come with all panel lines, Duz fasteners, screws and over 20,000 molded rivets; all hardware, retractable landing gear, wheels, fuel tanks, fuel filler valve, etc., are included; 12-page illustrated instruction manual.

Comments: I am so pleased with my P-51D that I took it to Top Gun 1996. Although the kit isn't inexpensive, I think that it's a very good value for a very special aircraft. Expect to have this plane completed and flying in about 100 hours.

Hits
- Excellent surface detail.
- Very scale lines.
- Good instructions.
- Well engineered.
- Complete kit.

Misses
- The elevator must be built, shaped, fiberglassed and detailed to match the rest of the aircraft.

Moki Mustang Muscle



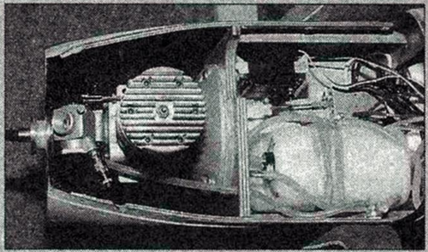
This is the Moki 1.8 engine with the tuned pipe on the test bench. This whole assembly fits inside the fuselage.

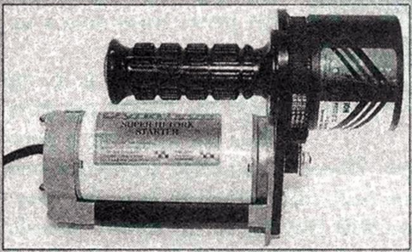
The scale size of this P-51D model was determined with regard to the size of the engine that was to be used in it. This approach to kit design led to a scale Mustang with no unsightly engine parts showing.

I chose to use the Moki* 1.8 engine and tuned pipe that Aerotech offers as options for this project. Its power-to-weight ratio is unsurpassed by any comparable engines on the market. After I had broken it in, the Moki provided approximately 21 pounds of thrust with an 18x8 propeller turning 8,900rpm. This means really good aerial performance for a 25-pound model like this P-51D! The custom-made tuned pipe is enclosed in the fuselage and exits from the rear of the oil cooler. A duct inside the fuselage draws the air through the fuselage and insulates the pipe from the other components in the airframe. After some 18 flights, I haven't seen any signs of the engine overheating or noticed any damage to other components in the airframe.

After the engine had been run, I found that the fuel had built up around the plug, and this made it a little hard to start until all the old fuel had burned off. To solve this problem, I used a Miller R/C Products* large engine starter—a Sullivan starter and a belt-driven reduction system that provides very high torque output at low rpm.

A big advantage of the enclosed installation is a reduction in noise. When the engine and pipe combination is installed in the aircraft, it sounds significantly less noisy than when it is run on the test stand. Sound readings with the Moki 1.8 engine, pipe and propeller combination measured less than 98dB. The engine is mounted inverted and runs very well this way, even at idle!





Left: this is the view when you look into the front engine compartment. The Moki 1.8, one of the two fuel tanks, the throttle servo, retract servo, retract valve and air tank are all shown here. The radio gear is in a compartment under the fuel tank. Right: the Miller R/C Products starter is helpful to start the engine.

The inner and outer gear doors come with vacuum-formed inside detail and are attached to the landing gear in a similar fashion to those on the full-size airplane. An optional scale package, including exhaust stacks, gas caps, bomb-drop hard points, machine guns, IFF lights, navigation lights, etc., is available to completely detail the airframe. With this and the optional scale cockpit interior kit, you will have a real competitor!

RADIO AND SERVO INSTALLATION

You'll need a minimum of six channels for aileron, elevator, flaps, rudder, throttle and retracts. With a seventh channel, you can also have "droppable" stores, such as bombs or drop tanks. I used a Futaba* 7UAP Super with an S134 ¼-scale servo for the elevator. Standard servos were used on the throttle, retract and flaps; 9302 high-torque servos were used on the ailerons.

Pushrods connect the control linkages to the control surfaces; the exception is the rudder and tail-wheel assembly, which is controlled by a pull/pull system. To mini-

FLIGHT PERFORMANCE

• *Takeoff and landing*

Takeoffs are very similar to those of the full-scale P-51. A fair amount of right rudder is required for the rollout. The plane tracks straight, but some right rudder is needed during climb-out to counteract torque. Rudder pressure is released as the plane picks up speed.

Landings are typical of planes with flaps. On the crossleg, the flaps are deployed approximately 15 degrees, and the throttle is brought down about 20 percent. My P-51D was equipped with Servo Slow, a device available from Aerotech that allows you to deploy the flaps slowly in up to 10 seconds. With the combination of slow flap deployment and reduction in engine rpm, you should see little or no ballooning when the flaps are dropped.

Drop the gear on final. The final approach should be fairly high with a nose-down attitude. Power is held in at about 25 percent until the plane is just over the runway. Once the plane is about 5 feet off the runway, pull off all power. The plane will slow quickly. Hold elevator to flare the plane.

• *High-speed performance*

I estimate the top speed to be around 90mph. This plane goes exactly where you point it. I found no bad high-speed characteristics with the recommended control throws. There's no tendency to snap out of maneuvers with full deflection.

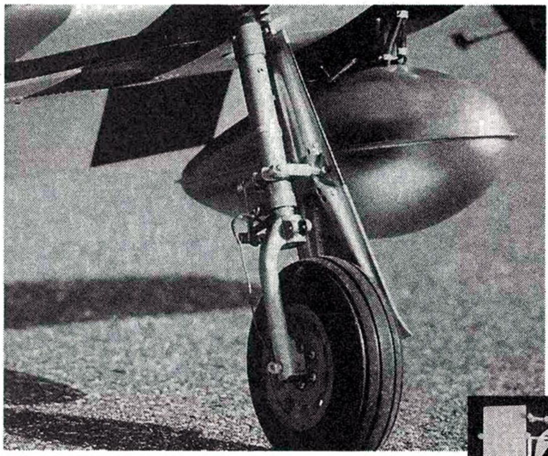
• *Low-speed performance*

I was surprised that at slow speeds, the airplane continued to respond efficiently on all control surfaces. When the airplane is slowed to below the stall speed, the nose drops predictably with no sign of tip-stalling.

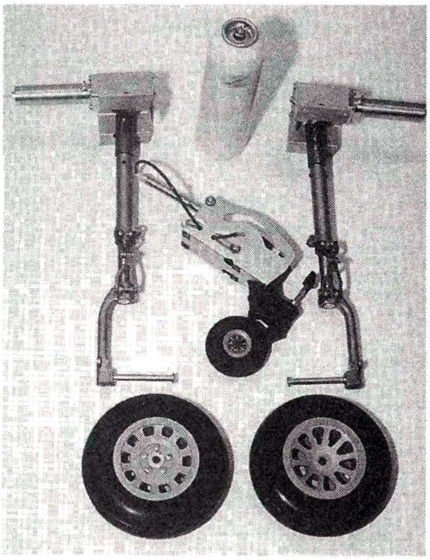
• *Aerobatics and scale flight*

The full-size Mustang never did Lomcevaks, so I never tried one with the model. Scale aerobatics are very nice. Big loops, split-S's, Immelmann turns and inverted flight are all predictable and smooth. In an early flight, I had too much elevator input, and this caused the plane to snap at the top of a loop. Letting the nose drop and neutralizing the controls allowed the plane to pretty much recover on its own.

This airplane will require more skill to fly than pilots working on their second model probably have, but if you have experience with pattern or sport acrobatic models, the transition to this airplane should not be too difficult.



The installed landing gear looks very realistic.



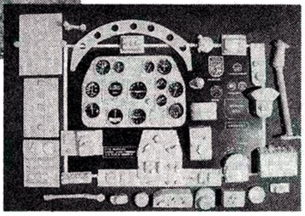
The Century Jet landing gear as it comes with the kit. The tailwheel assembly is made by Aerotech.

mize the possibility of radio interference caused by the carbon fiber, a Hayes* vertical whip antenna is used. Don't worry about the scale look of the airplane; the antenna can be unscrewed from the airframe when it's not in flight.

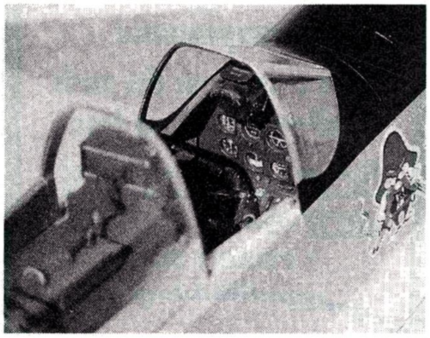
FINISHING

The leading edges of the flaps and ailerons and the elevator need to be glassed. The rudder will be covered with cloth if you want to replicate the full-size aircraft. The rest of the structure has a gel coating that gives it a very smooth finish right out of the box. To prepare my surface, I sanded the entire structure with 400-grit and then 800-grit wet-or-dry sandpaper. Because of the molding process used, some panels and rivets at the wing's leading edge are left out. These can be added before you paint. Panel lines can be easily cut in with a small pattern file. The kit includes a small cutting tool to be used in your Dremel, and it will allow you to add any missing rivets.

My P-51 is finished with an acrylic lacquer. This type of paint covers quickly and is a bit lighter than many other paints. I used scale, dry-transfer TAGS* markings, which are applied by being burnished directly onto the aircraft structure. They do not crack when applied and are extremely thin. All the panel lines and rivets remain visible through the markings. When the plane is complete, a quick clearcoat makes them permanent.



The optional cockpit kit really finishes off the airplane.



CONCLUSION

Although this is not an inexpensive kit, if you look at everything that is included, you will agree that it is a good value for a very special aircraft. Expect to have this plane completed and flying in about 100 hours.

I am so pleased with my P-51D that I took it to Top Gun 1996. Whether you want a scale Sunday flier or a competition aircraft, this kit could very well be what you are looking for.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

About the author

Jim Sandquist took second place with this Aerotech P-51D in Military Scale at the Toledo show this year, and he flew the model at Top Gun '96, where it earned a static score of 96.25 and finished in the top 20 overall. Jim also built a second, "practice" Aerotech P-51D that was featured on the August '96 cover of Model Airplane News. *As for his next scale project, Jim told us that he's thinking of building a third Mustang!*

Pilot PROJECTS

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable. We receive so many photographs that we are unable to return them.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1996. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

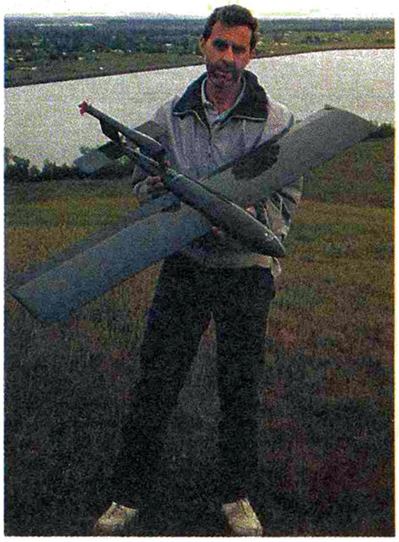
Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035.

SUPER STERLING

Rainer Eckert of Kirchheim unter Teck, Germany, sent this photo of his kit-built Sterling Corsair. He added a J'Tec instrument panel and a Williams Bros. pilot for realism. With an O.S. Max .15 FP engine running on a 100cc fuel tank, flights are 15 to 20 minutes long.

MILLER MUSTANG

Richard Janus of Mission, British Columbia, Canada, built this 29-pound Byron P-51 and powered it with a Quadra 52. He used automotive paint, decals and three layers of clearcoat for the Miller racecar finish, which he says he applied "just to be a little different from the usual warbird detailing." The model is also equipped with a smoke system.



BUZZ BOMB

This original-design V-1 slope soarer is the handiwork of Jim Babcock of Chico, CA. The model has a carved, hollowed balsa fuselage and "pulse jet" and a 4-foot-span foam wing. The 30-ounce soarer is covered in MonoKote and has aileron and elevator control, with which it flies well in winds of from 8 to 25mph. Jim notes, "The pulse jet seems to offset the rather small vertical tail surfaces with more area; in fact, the air moving through it tends to promote stability while causing very little drag."

GIANT FUN

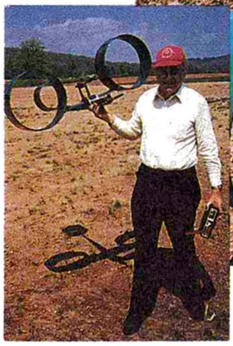
Mal Richards of Whangarei, New Zealand, designed and built this 22-pound model for fun flying and engine testing. The $4\frac{1}{2}$-inch-thick wing has a span of 102 inches and a chord of 24 inches, and it has built-up ribs. The model's undercarriage is made of golf-club shafts that have been rubber-mounted. A 60cc Echo twin chainsaw provides the power.

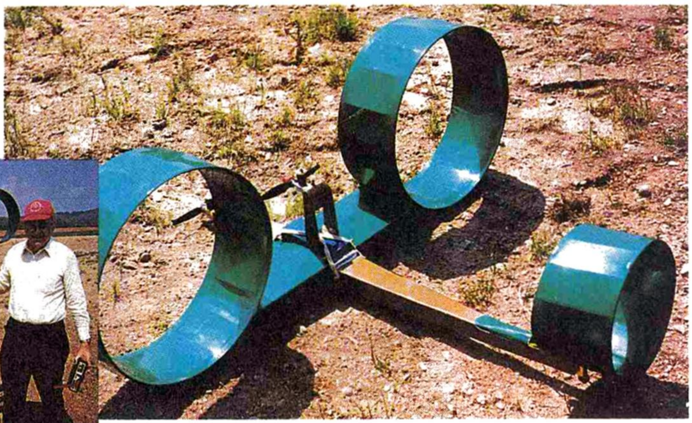
O.S. X 5

Bud Gewinner of St. Louis, MO, designed this 50-inch-span Stearman 17 from a scale 3-view and equipped it with an O.S. Surpass engine, to which he added four balsa cylinders. Bud says that the fake cylinders and their mounting hardware add only $2\frac{1}{2}$ ounces to the model and that the "live" cylinder is at the top left in the photo.

RAAF FIGHTER

This Top Flite Gold Edition P-40E is Darrell Lang's first scale airplane; he spent more than 15 months building it. The model is equipped with a SuperTigre .75 engine, Robart air retracts, a drop tank, split flaps, handmade, music-wire gunsights and a sliding canopy that works with the retracts. The pilot's head turns with the rudder input. Darrell used Model Master paints for the color scheme, and all the insignias and rivets (more than 7,100!) were hand-painted. The panel lines are $\frac{1}{32}$-inch-thick MonoKote strips.





DOUBLE RINGER

Karl Benson of Wyomissing, PA, sent in these photos of Titus Riegner and the hoop plane he built from *Model Airplane News* plans. Titus first flew the model with a Cox .049, then added another .049 for more power. Karl says, "He did a few snap rolls—incredible! It looked like it came out of the snap roll in 15 or 20 feet!" Karl and Titus are the vice president and historian, respectively, of the Cocalico Prop Busters, a mostly electric R/C club with a newly graded and seeded 50-acre field.

METEOR MK IV

Alec Cornish-Trestrail of Cheltenham, Gloucestershire, England, made this $\frac{1}{6}$-scale Gloster Meteor's epoxy/glass and carbon-fiber fuselage using his own molds; he built up the 78-inch-span balsa/plywood wings and tail surfaces with foam outer wing panels. The model is powered by two O.S. engines driving Ramtec fan units with JMP tuned pipes, and it has 17 servos. Alec used HobbyPoxy paints to duplicate the colors of the Gloster demonstration aircraft; he says that the 32-pound model is very quick and aerobatic.

TERRIFIC TROJAN

Former Marine aircraft mechanic Frank Budo of Harahan, LA, built this $\frac{1}{6}$-scale Pica T-28B from a kit. He installed an O.S. 91 Surpass, B&D air retracts and functional, spring-loaded gear doors. The 11-pound model is finished in Super Shrink Coverite and Krylon paint; Frank made all the numbers and letters using handmade, drafting-tape stencils.

MODEL AIRPLANE NEWS CONSTRUCTION

Twin Trainer TT-1

Double your pleasure, double your fun!

by ROY DAY

MULTI-ENGINE aircraft are interesting and offer modelers many opportunities—especially because so many are seldom modeled; but there's a downside to multis—particularly twins: the dreaded "engine out," which may result in a crash.

I had already tried my hand at electric twins—the Dornier DO-28 and the deHavilland Hornet (*Model Airplane News* plan FSP12921). They're easy to fly because the motors are wired in series, and that rules out any chance of an "engine out." I figured it was time to accept the challenge of designing a glow-powered twin, but I decided my first attempt should be a simple trainer that would give me some experience. Of course, I didn't want it to look like a box with a wing, so I gave it the lines of a short-haul transport. The Twin Trainer TT-1 has conventional gear that works well on grass runways, and its twin-tail arrangement allowed me to work out design problems for future scale projects. I used economical, but very reliable, O.S.* 25 FP 2-stroke engines, which gave plenty of power. The result is a stable airplane that's both fun to fly and challenging. During its more than 40 flights, I've learned a lot.

CONSTRUCTION

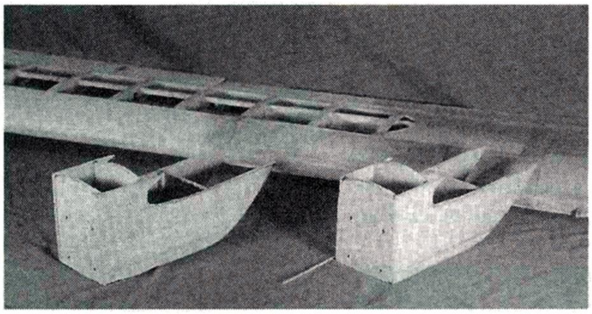
• **Wing.** The standard wing design has forward and aft spars and forward sheeting to give a strong D-tube construction. It's straight, so the ribs are all the same. You do have to cut the center four ribs so that the plywood dihedral brace can be inserted as shown on the plans. First, be sure to drill holes in the ribs for whichever type of aileron pushrods you plan to use. Also, decide how you will route your flexible cables from the wing center out to the engine nacelles. Of course, you could use one servo in each nacelle for throttle. If you do, you'll need a way to route your servo connections using a Y-connector.

With the plans protected with wax paper or plastic, start one wing panel by pinning down the forward and aft bottom ¼-inch-square balsa spar caps over the plans. Install all except the middle four ribs. Also glue in the LE and TE. Now add the top spar caps. Put in the plywood dihedral brace with epoxy, and install the remaining center ribs. Add

The Twin Trainer has the lines of a short-haul transport but flies like a trainer.

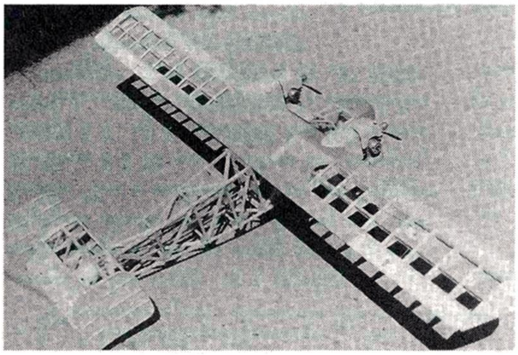
the filler blocks and two, 1/4-inch-diameter dowel wing pegs. Don't forget the shear webbing adds a lot of strength.

Remove the panel from the board, add the *bottom* sheeting and the aileron and throttle control cables and pushrods, etc. Having installed these, you can add the top sheeting and the rib capstrips.



The engine nacelles are simple box structures that are attached to the wing sheeting. Epoxy them on, and reinforce them with fiberglass cloth.

Now build the other wing panel in the same way. Join the two panels with the plywood dihedral braces and sheet the top. Now apply 2-ounce fiberglass cloth out past where you will attach the engine nacelles, top and bottom. Fit your ailerons, reinforce the areas where the wing-attachment bolts will be, and you pretty much have the wing finished.



The Twin Trainer's bare bones showing its simple, light-weight construction. This shows the short-nose, earlier configuration.

• **Engine nacelles.** Build over the top view of the plan, making sure you have a good fit at the wing LE and along the lower surface. Have the thrust line straight ahead and no downthrust. If you find a little downthrust helpful in flight, just put a washer under the upper bolts of the engine mount. Epoxy the nacelle to the wing and add fiberglass strips along the nacelle/wing joint for strength. In the bottom, build a hatch that's big enough to take your fuel tank. To protect the nacelle against fuel spills, coat its inside with thinned epoxy or polyurethane enamel.

• **Engine cowls.** The cowls serve only to give the model a finished look. If you want to leave them off, skip this section and go on to building the fuselage.

I decided to make the cowls of *papier mâché*, so I had to build only one plug, for which I used blue foam faced with balsa. You could make it entirely of balsa, but it is a bit more expensive. Mount the mold on a support that raises it above a base to allow the paper strips to hang straight down. Instead of using the usual paste wax as a release agent, I applied Scotch Plastic Tape™, which is stretchy and conforms nicely to the plug. It works well as a release agent. Ron Fikes, of Palo Alto, CA, suggests the use of Kraft brown wrapping paper instead of the usual grocery bags, alternating with layers of 2-ply paper towels. Yes, I said paper towels. The stretchy kind will conform nicely to the plug and will hold the brown paper strips in place.

Soak the strips of brown paper and paper towels in a white - glue/water mixture before applying them to the mold. Eight layers should be enough. Make the last layer with paper towel, which is easier to sand. Allow the paper to dry for at least 24 hours; longer is better. Do your sanding with the cowl on the mold for support. If the surface is not smooth enough for you, spread on some spackle-type filler diluted with water to whipping-cream consistency. Where there will be cutouts and at the attachment points, reinforce the inside of the cowl with fiberglass cloth, then finish it with a fuelproof paint of your choice.

SPECIFICATIONS

Model name: Twin Trainer TT-I

Type: sport twin

Wingspan: 72 in.

Wing loading: 23 oz./sq. ft.

Length: 44 3/4 in.

Weight: 5 lb., 12 oz.

Radio req'd: 4-channel (throttle, elevator, rudder, aileron)

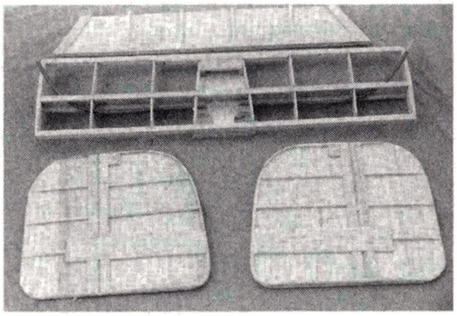
Airfoil: semisymmetrical

Construction: built-up with balsa and ply

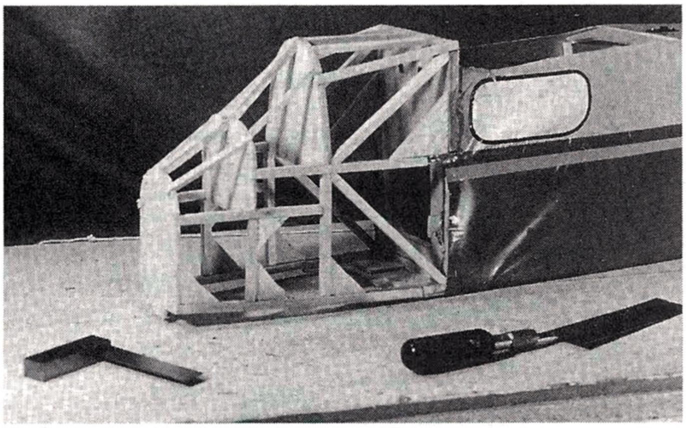
Engines: two .25ci 2-strokes

Comments: the Twin Trainer is straightforward to build and stable enough to to be a good choice to begin your experience with twins. It's fun and challenging to fly.

• **Fuselage.** This is a conventional stick construction with a few formers in the forward part. Build the two sides over the plans; then, over the top view, install the aft crosspieces and the no. 4 bulkhead. With the fuselage structure still pinned to the board over the plans, add formers 3, 2 and, finally, 1 as you bring the longerons



The twin vertical tails and the elevator are made of balsa-sheeted foam-core and 1/8-inch-square false ribs on both sides. The stab is a symmetrical section that contains the flexible rudder pushrods.



The forward part of the fuselage was redesigned after the 10th-flight crash. The lengthened fuselage nose improved the looks and provided room for a central fuel tank.

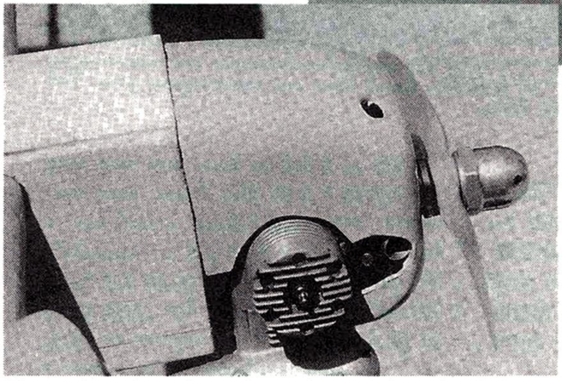
together at the nose.

Now complete the forward part of the fuselage by adding the bracing to support the cabin roof, windshield and nose hood. Don't forget the generous hatch in the bottom; it will give you access to a central tank and to any component you need to install in the nose for balance. Make the hatch big enough to get your hand through. The fuselage you see on the plans is the version with the longer nose—the result of a redesign after an engine-out crash on flight no. 10. Build the nose cone of blue foam covered with fiberglass cloth.

The wing is held on with two 8-32 nylon bolts and the wing pegs. The 8-32 bolts have proven adequate for flying, including aerobatics, and have saved the wing in two crashes. Anything stronger would probably have led to the wing's being damaged in a crash. Similarly, the landing gear is fastened with four 10-32 nylon bolts threaded through the ⅛-inch plywood mount and into hardwood blocks. This scheme makes it easy to replace the landing-gear bolts after an accident.

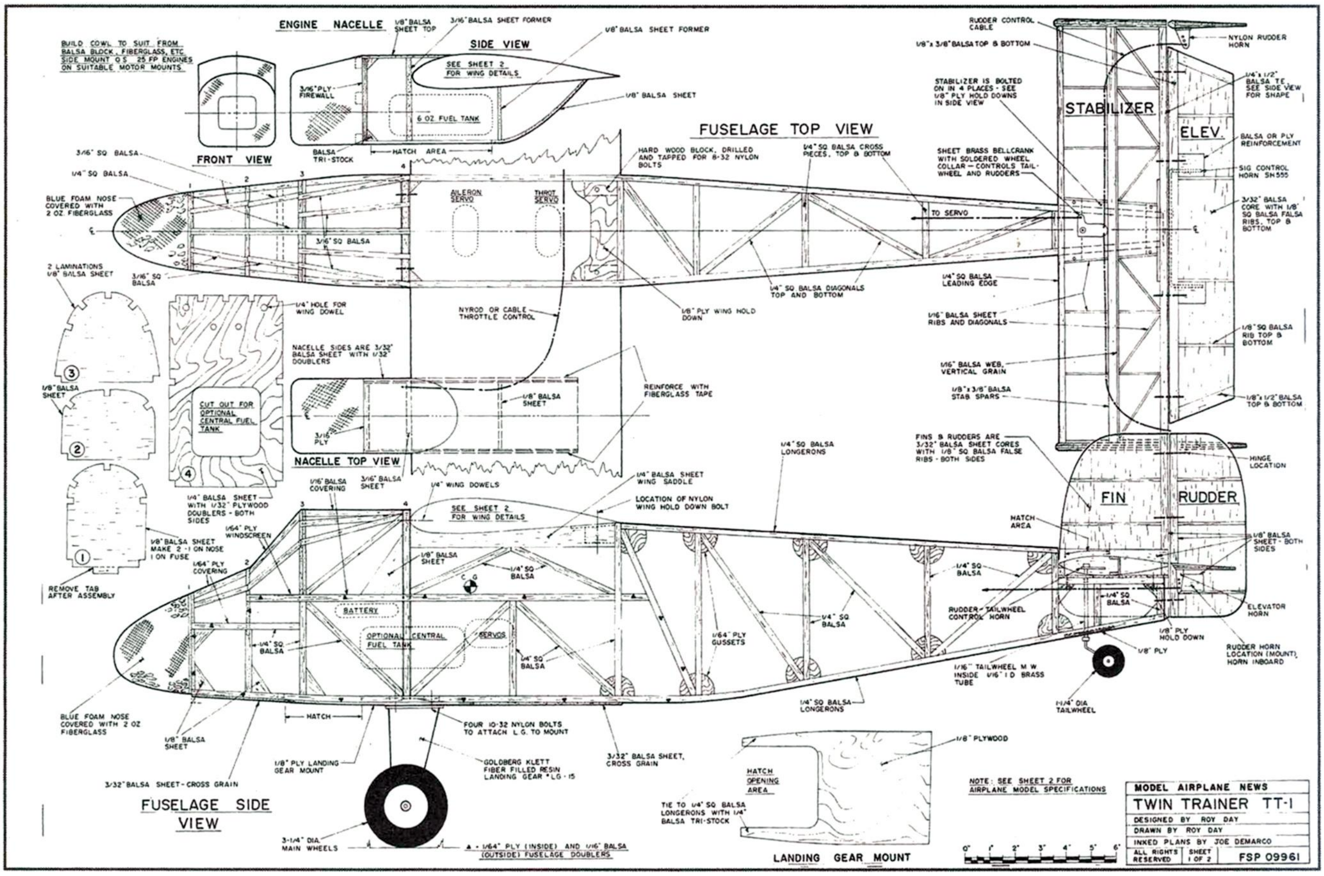
• **Tails.** The twin vertical tails make the construction a little more difficult. The stab uses a symmetrical built-up section that contains the Nyrod pushrods that go to the two rudders. The bellcrank that drives the rudders also actuates the tailwheel. The entire tail assembly is bolted to the fuselage with four 6-32 nylon bolts. Build the stab as you would build a wing with ribs, spar caps and shear webbing. The diagonal bracing in the stab adds torsional stiffness, which is needed to resist the flight loads of the twin rudders. The elevator and vertical tails use a center core of 3⁄32-inch-thick balsa sheet with ⅛-inch-square false ribs on both sides. Build an access panel of sheet balsa over the stab bellcrank so you'll be able to adjust the tailwheel and rudder pushrods.

The completed mold is shown with the materials needed to make the papier mache engine cowls: white glue/water mixture, Kraft brown paper and paper towels.



The cowl neatly encloses the engine and gives the airplane a finished look.

Assemble the sub-assemblies, and make a preliminary balance check before covering the plane. Temporarily place the servos and battery in the fuselage while you balance the airplane. With the added space in the forward fuselage, components can be installed as far forward as necessary to achieve the proper CG location. I make it a practice to try very hard to balance an airplane correctly without adding ballast. In this case, I only had to put the battery forward in the cabin as shown on the plans. Be sure to leave space for the central tank. Once you've deter-



TO ORDER THE FULL-SIZE PLANS, SEE PILOTS' MART.

FLIGHT PERFORMANCE

• *Takeoff and landing*

When you are ready for that first takeoff, advance the throttle slowly. Don't worry; the two 25s will give you plenty of power. If one engine accelerates faster than the other, the plane will yaw to the right or left and you will need to be on the rudder quickly. Hold the tail down with up-elevator, steer with the tailwheel until you have enough speed to make the rudder effective. Gain plenty of speed before you lift off; don't pull up too steeply. Once in the air, if the engines aren't closely matched, you may find it necessary to put in some rudder trim. From that point on, the plane flies just like a single-engine one. On my Twin Trainer ,the right engine is nearly new; the left one has a lot of time on it. The right engine is stronger and accelerates faster, so I have to be careful to advance the throttle slowly to avoid yaw problems. Two matched engines would avoid this.

The Twin Trainer lands better on the main gear with a little power. Don't try to do a full-stall three-point touchdown. The fuselage has a lot of side area, and if you have a strong cross-wind, it will tend to drift off the runway during the approach. Just be mindful of it and make corrections. Because the thrust line is high, when you land on grass, you need to apply a little up-elevator during the roll-out to avoid a nose-over. Actually, with the Twin Trainer, it isn't much of a problem; it just tilts up on the nose and the engines keep running.

• *Low-speed performance*

At low speed, the TT-I is very stable and, as previously mentioned, you only need to be careful to advance the throttle slowly in case one engine accelerates faster than the other.

• *High-speed performance*

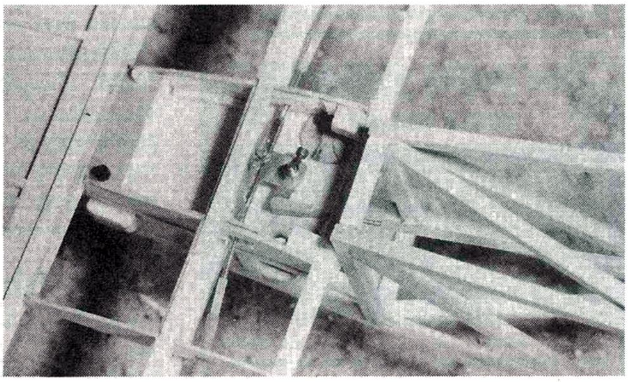
The two O.S. 25 engines furnish plenty of power, and at high speed, the plane handles pretty much like a single-engine airplane. Because of its lightness and wing loading, I wouldn't recommend engines larger than the 25s.

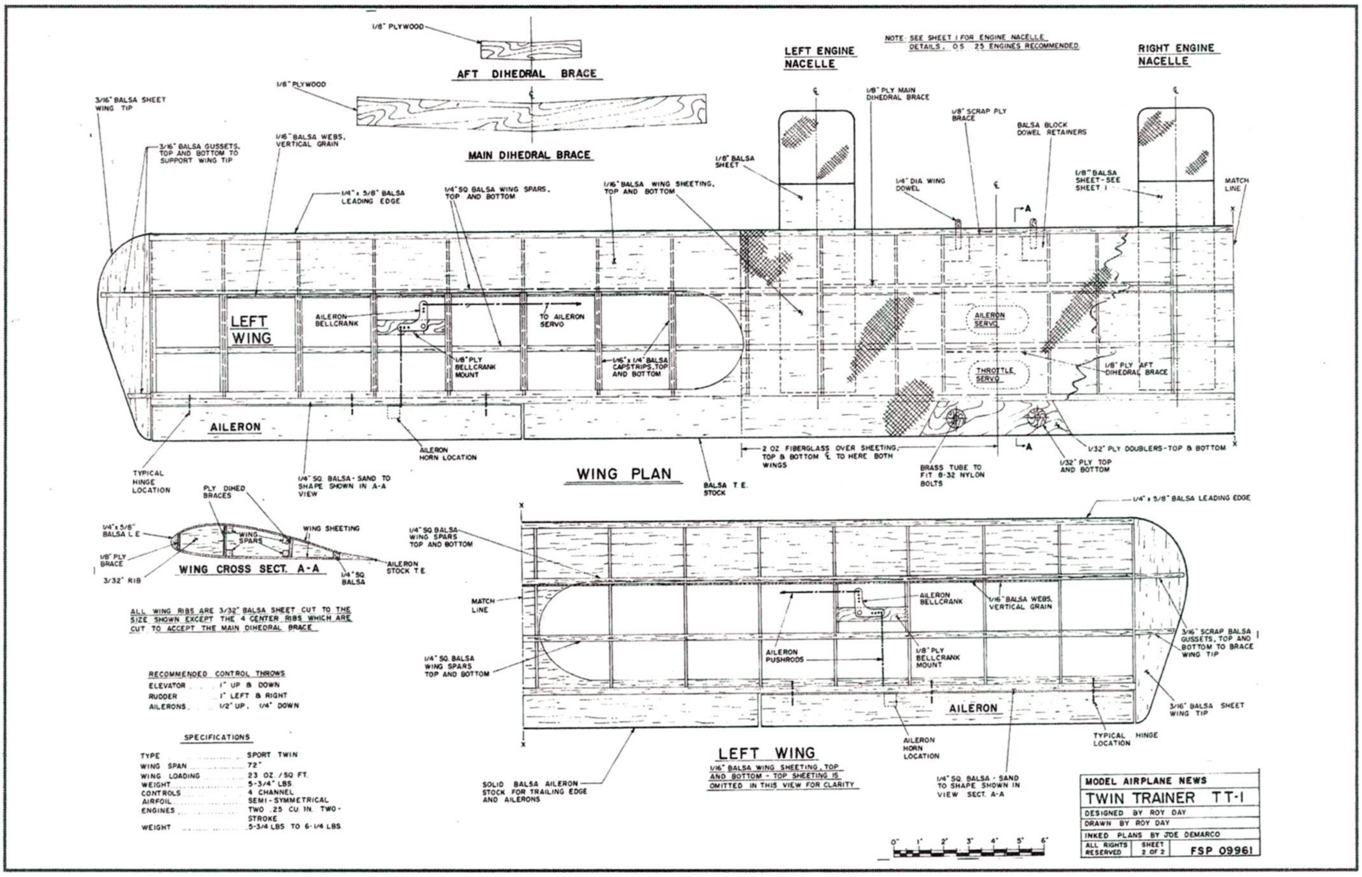
The TT-I was not designed for aerobatics but it has no trouble doing loops, Immelmanns and sloppy rolls. Regardless of which flight maneuvers are being done, the sound of those two engines beating together always draws the attention of other fliers and spectators.

mined where the elevator and rudder servo will go, install the pushrods before you cover the model. After covering the wing, put in a couple of degrees of washout (wing twist) by heating the wing while you twist it. The washout will give you a nice controllable stall.

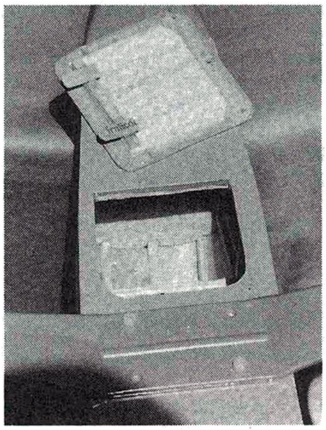
• **Single fuel-tank system.** Many scale airplanes don't have engine nacelles large enough to hold a tank of an adequate size as well as the retracts. Cline and Associates'* simple, lightweight Proportional Control Fuel System (PCFS) allows you to have a single tank in the fuselage. It uses exhaust or crankcase pressure from

A wheel collar and a bellcrank of sheet brass drive the rudders and the tail-wheel. The entire tail assembly is fastened to the fuselage with four 6-32 nylon bolts.





the engine(s) through a check valve to pressurize the tank. A postage-stamp size regulator in the fuel line ensures positive fuel flow to the carburetor; the tank's position is no longer critical because the system is pressurized. *[Editor's note: see Roy Day's review of the PCFS system in the March '96 issue of Model Airplane News.]* With the PCFS, I mounted one 10-ounce tank in the bottom of the fuselage and ran both pressure and fuel lines out to each engine. After more than 15 successful flights, I am very pleased with this setup. Once the engines have been adjusted, they never run lean in flight. The plans show provision for a single central tank as well as for the customary tank in each nacelle. For reliable performance, I recommend a central tank with the PCFS.



Provide a hatch in the bottom of the fuselage to allow access to the forward part of the fuselage. Landing gear is mounted with four 10-32 nylon bolts threaded into hardwood blocks.

FLYING THE TWIN

I now have over 40 flights on the TT-1—and two minor crashes. On the 10th flight, I lost one engine on takeoff at about 15 feet. I cut the throttle to idle (standard emergency procedure), but not fast enough to stop a yaw to the right and a nosedive into the ground. This caused me to redesign and rebuild the forward part of the fuselage.

Then, landing after the 34th flight, I decided to go around again. I made the mistake of jamming the throttle to pick up speed, and the differing accelerations of the left and right engines yawed the plane and caused another minor crash. That experience really emphasized that both engines should accelerate at the same rate, and you should never advance the throttles quickly unless you are at altitude and prepared for an emergency.

Despite these minor problems, this model is a lot of fun to fly—a stable airplane to begin your experience with twins; and it's straightforward to build. It has plenty of space in the fuselage, so it can serve as a test bed for options like the central tank and the PCFS. Once you've gained confidence with the Twin Trainer, you'll be able to take on any number of interesting multi-engine airplane projects. If I can be of any assistance, contact me at 11709 Magruder Ln., Rockville, MD 20852; (301) 468-0915; fax (301) 770-2616.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

About the author

Roy Day is an aerospace engineer, now retired from NASA after many years in the manned space programs. He has designed a number of model airplanes and published numerous articles.

Adjusting Twin Engines

The first question people will ask when they see your twin will be, "How do you synchronize the engines?" Your answer?: you don't have to. You need two reliable engines that will run with within about 400 to 500rpm of each other at full throttle. They should have similar rates of acceleration.

When you tune the engines for flight, don't hurry. Tune the left engine first, making sure that it is on the rich side. Then shut it down and repeat the procedure on the right engine. Cut the right engine, top off both tanks and then start both engines, beginning with the left one. Assuming you're right-handed, by starting the left engine first and then moving to the right, there's less chance you will get your arm caught in the prop.

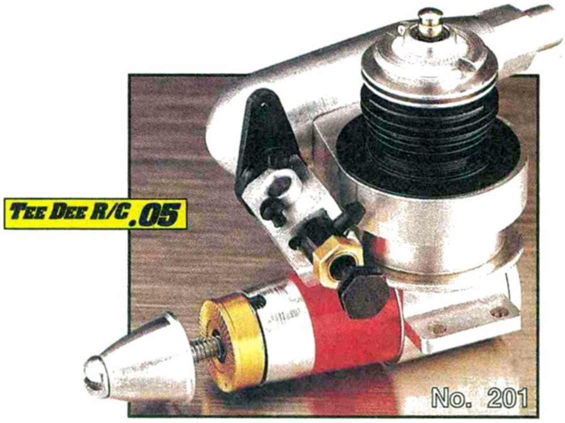
Twins require a little extra attention with regard to props. Because the engines are close to the fuselage, there isn't room to use a standard glow-plug lighter with Ni-Cd battery; you need the clip-on type. I made one out of a clothespin, some brass sheet and an old charger wire.

When both engines are running well, a check with your tach will verify whether your engines' rpm are close enough. On the low end, you can adjust the throttle linkage for idle. If they are too far off on the high end, enrich the mixture on the high engine until the rpm are within about 500. Check all of your flight controls for direction, and you're ready to fly.

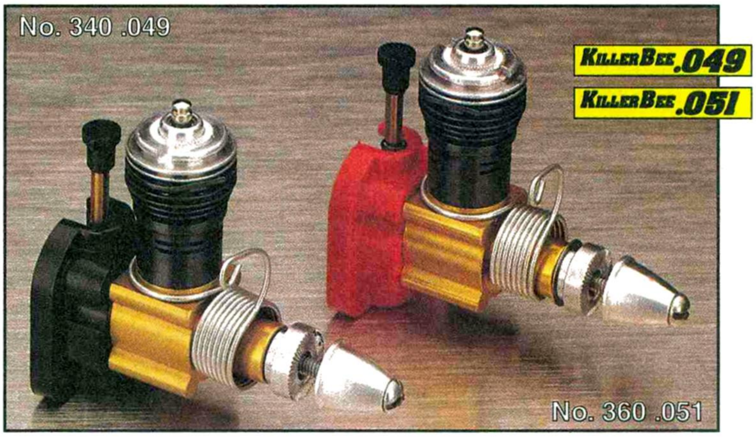
CHOOSE YOUR WEAPON

Whether you're into speed, sport, scale or duration, Cox has the right engine for you.

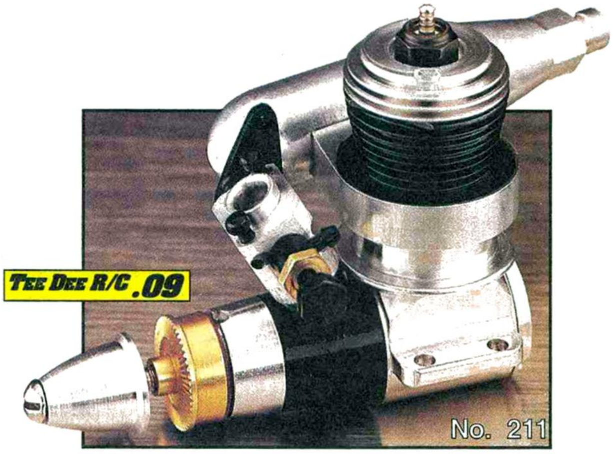
The Cox Texaco .049 has become the standard for 1/2A R/C Duration flying. Now, to meet the competition requirements of both long and short tank events, the engine is available in two different tank sizes and also includes a "zero drag" spring starter. When competing in 1/2A Texaco & Duration events or out for a Sunday afternoon fun fly, smooth steady power and fuel economy is the secret to great performance! The Cox Texaco features a high velocity venturi for improved fuel economy and a 5 fin glow head for extra cooling when swinging a big prop.



The .05 is based on the popular Tee Dee .051 Competition engine. This is the lightest engine available with true carburetor and muffler.



Designed to run ultra fast with high nitro fuel on small props, the Killer Bee engines will clean up in Nostalgia Free-Flight. Available in both .049 and .051 sizes, the Killer Bees are ready for class 1/2A or A competition.



The .09 is a radio ready version of the powerful Tee Dee .09. The Tee Dee R/C .09 features true carburetion and muffler. Small size and weight allow the user to install this engine as a "Turbo-Boost" in most aircraft intended for 1/2A R/C flying.

The Dragonfly features an integrated throttle/muffler system, Snap Starter® for easy starting and oversized fuel tank with built in "clunk" system to allow inverted flight.

First introduced in 1973, the Black Widow is our most popular .049 reed valve engine! It's great for all types of control line models including 1/2A Stunt, Mouse Racing, Beginner Combat and Powered R/C Sailplanes, too.

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MODEL AIRPLANE NEWS
HOW TO

Control Linkages

Bellcranks, differential and dual-servo setups

by MIKE McCONVILLE

IN MANY MODELS, the ailerons and the flaps can not be connected to the servo with a simple torque rod; they must be connected either to a single servo via bellcranks, or to dual servos mounted outboard in the wing. Often, your choice of method depends on which model you are building, because some models don't have room in the wing for two servos. A bellcrank system, on the other hand, is usually built into a wing; because you can't get to this system to maintain it, install it with durable hardware.

DUAL SERVOS OR BELLCRANKS?

For aileron and flap linkages, I prefer to use outboard wing-mounted, directly connected dual servos. For a small additional cost, you'll have a rigid servo connection that is easy to install and maintain. In higher-powered performance models, this rigidity adds a good margin of safety against flutter.

If wing-mounted servos are not a possibility, install bellcranks. Because there are so many pushrod connections and moving parts in a bellcrank system, it's easy for "slop" to develop. Use high-quality hardware for the linkage connections from the servo to the bellcrank and from the bellcrank to the control horns (see my May '96 *Model Airplane News* article, "Control Linkages for Giant-Scale Models"). Because these linkages are built into the wing, any repairs will require major surgery. Connecting the linkage from the bellcranks to the servo can pose a problem, but the Du-Bro* aileron connector ball link (part no. 183) is made specifically to remedy this; it works well.

SETUPS

- **Bellcrank orientation.** For aileron linkages, orient the bellcranks in opposite directions; this will produce the desired aileron movement. For flap linkages, orient both bellcranks in the same direction, as shown in Figure 1; this will produce movement in the same direction.
- **Servo-arm orientation.** To achieve the correct movement when you use dual servos and a "Y" harness to plug both servos into the same receiver channel, the aileron servo arms should be oriented in opposing directions, and for flaps, they should both be on the same side as shown in Figure 2.

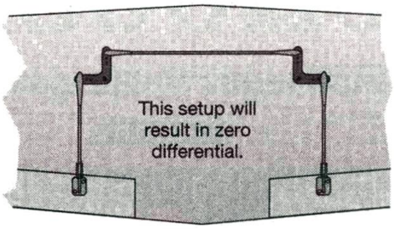


Figure 3A.

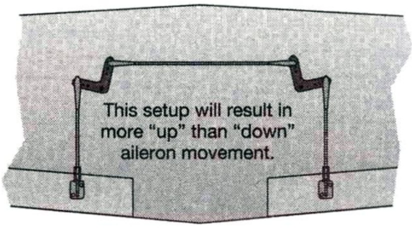


Figure 3B.

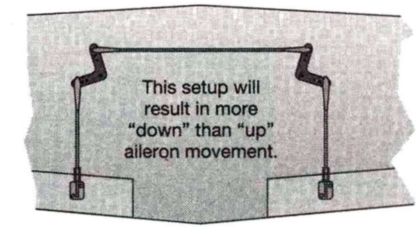


Figure 3C.

Aileron differential with bellcranks. All control horns are mounted on the bottoms of the ailerons.

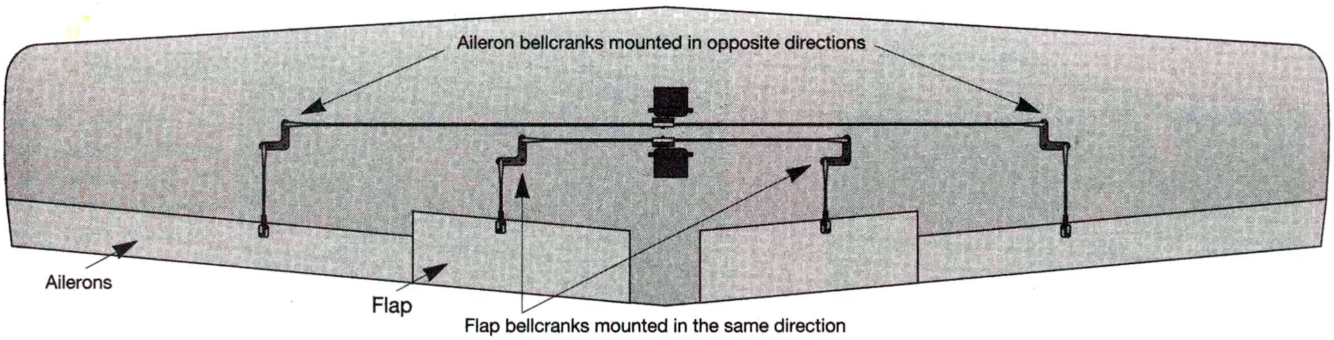


Figure 1. A typical wing setup using bellcranks for ailerons and flaps.

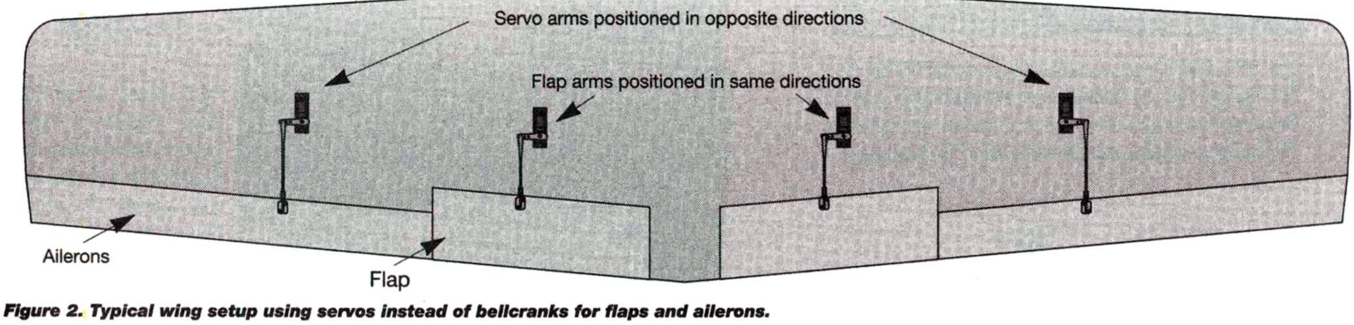


Figure 2. Typical wing setup using servos instead of bellcranks for flaps and ailerons.

AILERON DIFFERENTIAL

Often, you'll want differential in the aileron movement. "Differential" here simply means more movement of the control surface "up" than "down." Use aileron differential to correct adverse yaw and to control the roll axis of an aerobatic model.

• **Differential via bellcrank position.** Figure 3A shows a bellcrank system with no differential movement. In this setup, the arm of the bellcrank that is connected to the aileron is perpendicular to the pushrod, and the arm that is connected to the servo is perpendicular to its pushrod when at neutral. Figure 3B shows the neutral position of a setup that will produce more "up" than "down" movement, assuming that the control horns are on the bottom of the control surface. Figure 3C shows the setup that will produce more "down" than "up" movement, assuming the same horn attachment. The drawback to this method of setting differential is that, once the model has been completed, it is not easily adjusted.

• **Differential via splined servo-output shaft.** You can adjust differential by changing the orientation of the servo arm by rotating it to a different position on the splined servo-output shaft. Again assuming that the horn is on the bottom of the control surface, Figure 4A shows the servo arm position with no differential, 4B shows how to produce more "up" than "down," and 4C shows how to produce more "down" than "up." The farther the arm is rotated from the zero position, the greater the differential movement. This method is preferred because it is usually easy to get to the servo so you can make adjustments quickly while you are trimming a plane.

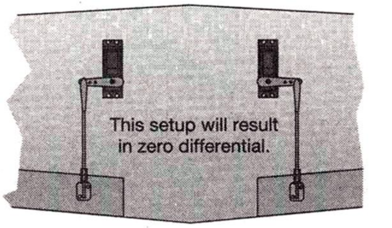


Figure 4A.

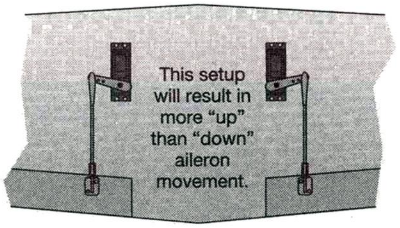


Figure 4B.

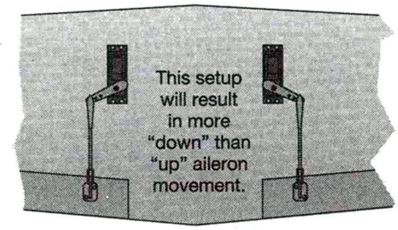


Figure 4C.

Aileron diffrential with servos. All control horns are mounted on the bottoms of the ailerons.

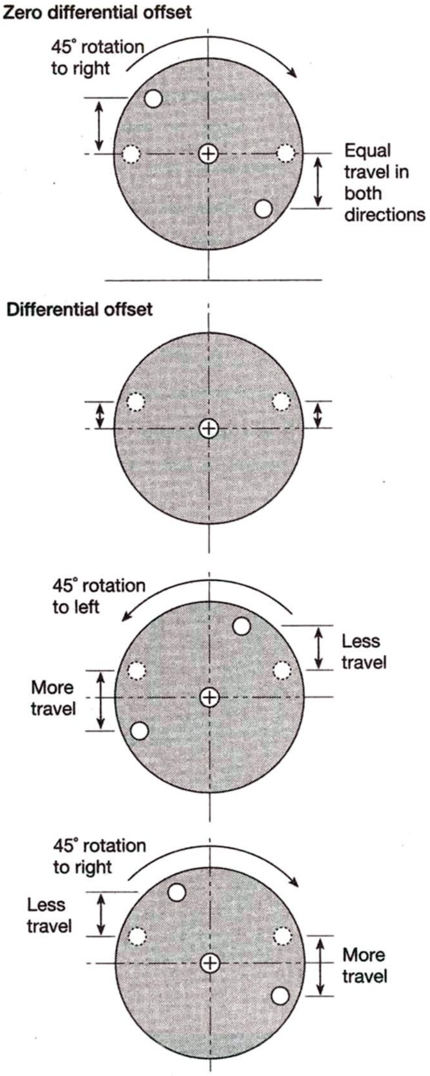


Figure 5. Servo-wheel differential

To set up and trim out an airplane properly, it is important to have a good, practical understanding of the mechanics of control linkages. In future articles, I will discuss ways to obtain the same results easily with computer-radio programming.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

About the author

Mike's father, Jim, has been involved with R/C since the early days of escapement, so it's only natural that Mike followed in his footsteps. Mike says, "I have been involved in R/C all my life and in almost every aspect of R/C aviation, including pattern, racing, sailplanes and helicopters."

MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

STARTING IN 1936, the U.S. used the Stearman Model-75 Kaydet as a primary trainer. The most common versions were the Army's PT-17 and the Navy's N2S. In 1939, the Stearman Aircraft Co. became part of Boeing, and roughly 10,000 of the biplanes were built through 1945. A relatively large number of these 220hp, fine flying, hardy biplanes still exist today. Many have been retrofitted with more powerful engines and are used as crop dusters and aerobatic show performers. The ultimate Stearman is equipped with wheel pants, a full cowl, a powerful 450hp engine and upper wing ailerons and makes the excellent aerobatic airplane commonly known as the Super Stearman.

Close-up of the cockpits and instrument panels.

A superbly detailed 1/3-scale barnstormer

Super Stearman

Balsa USA

by ALEXANDER MULLER

THE KIT

This is an excellent Balsa USA* kit. The wood and hardware are first-class, and everything you need has been included: two 24-ounce tanks, 7-inch main wheels, 3-inch tailwheel, plastic prop hub, all wire fittings, control horns, cables, pilot seats, hatches and much more.

Be prepared to spend a few hours sorting through all the die-cut wood and stock wood pieces and to familiarize yourself with the myriad hardware parts. Although most of the die-cutting is clean, some parts may need sanding or trimming. And as the instructions suggest, be sure to round off (file) the edges and corners on all the steel fittings. This is by no means a kit for beginners, but it is not unduly difficult; it took me 412 hours over six months to complete mine.

The plans consist of seven very large sheets, and a 41-page instruction booklet is also included. All the required steps are detailed in the instructions, but not all are correct or in the best sequence. If you are careful and read ahead a couple of pages, however, you won't have any problems.

SPECIFICATIONS

Type: 30-percent-scale Stearman PT-17 biplane

Manufacturer: Balsa USA

Wingspans: 116 in. (top), 113 in. (bottom)

Wing area: 3,800 sq. in.

Weight: 50½ lb.

Wing loading: 30.61 oz./sq. ft.

Airfoil: semisymmetrical

Length: 92 in.

Engine req'd: 4.2 and up

Engine used: 3W-120B2

Radio req'd: 4-channel (aileron, rudder, throttle, elevator)

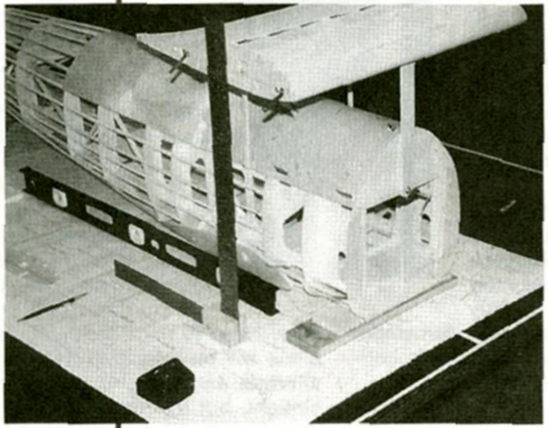
List price: $784.95

Features: all balsa and plywood construction, aluminum sheeting and complete hardware; comes with everything needed to build the model; two 24-ounce tanks; 7-inch main wheels; 3-inch tail wheel; plastic prop hub; all wire fittings, control horns, cables; pilot seats; hatches; and much more. The plans consist of seven very large sheets, and a 41-page instruction booklet is included.

Comments: not a beginners' kit but not exceptionally difficult to build; very stable; flies as you would expect a large R/C airplane to fly. I used a backup system consisting of two 6V, 1300mAh packs for the receiver (truly redundant right up to the receiver, with dual switches and blocking diodes). One 4.8V, 1300mAh pack is used for the ignition, and I converted a Sonic Tronics* fuel pump, two Varsane* check valves, one 4.8V 600mAh pack, and a limit switch for the smoke system.

Hits
- Value for money.
- Excellent hardware and wood.
- Well-drawn, full-size plans.
- Very helpful instructions that make the project move along (also see "Misses").

Misses
- Landing-gear assembly method. If you are not experienced in brazing, this might be a problem.
- Inaccuracy of some steps in the instructions.



It's easy to align the wings and the center section of the top wing if you draw a centerline on the ribs before assembly. Use a flat work surface and measure up to the centerlines.

CONSTRUCTION

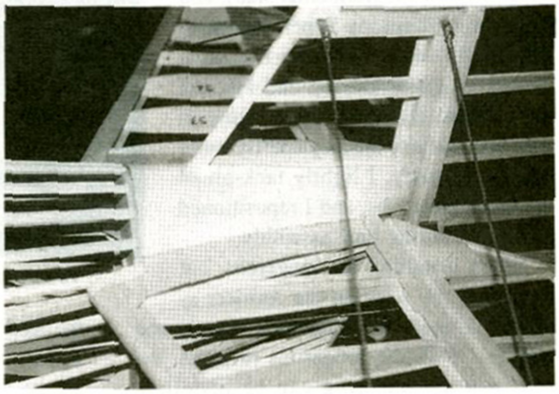
• **Wings**. These take a while to build because they are large and there are four panels plus a center section. My only difficulty was in identifying the exact positions for some of the wire fittings. The holes for all the fittings are clearly marked, but in a couple of places, it is not easy to tell which fitting goes into which hole. I ended up faxing a sketch describing my dilemma to Balsa USA, and they promptly faxed me back the clarification.

You will also find that some of the stock wooden parts are barely long enough for the intended application, and two or three were actually just shy of their depicted lengths. (This was because the plans had expanded in the very humid conditions.) But these deviations are minor and can be easily accommodated if you catch them early. Read several instruction steps ahead, and study the plans carefully. On the wings, I substituted ⅛-inch, 5-ply ribs for the supplied ⅛-inch lite-ply, load-bearing ribs (the ones with the steel fittings), and I cut them out myself. I also added the handholds in the center-section trailing edge.

Super Stearmans have ailerons on their top wings. These ailerons are as wide as the lower ailerons but are only six bays long (from rib W6 at the wingtip to W4 past the plywood rib). When the top ailerons are added, the lower ailerons have to be built shorter by three bays at the inboard end. Even though there are many types of Super Stearman, most have the ailerons as I just described.

I made the interconnecting aileron rods out of ⅜-inch-diameter hardwood dowels with 4-40 threaded rod ends and threaded clevises. I used spare servo arms as connecting-rod attachment fittings for the clevises. This arrangement allows easy assembly at the field. The tail feathers, horizontal stabilizer and elevator were relatively straightforward to build. My only modification was to split the elevator to accept a servo for each half. The vertical fin and rudder went together without a hitch and were the easiest part of the entire project.

• **Fuselage**. This went together rather well. As with any model, make sure everything is square and properly aligned from the beginning, and the rest will follow easily. Note that the support braces and the bellcrank (for the rudder and tailwheel) are much easier to install while the main frame of the fuselage is being constructed. If, as I did, you wait until the instructions call for the installation of these parts (much later on) you will have to work through openings.



The tail feathers are easy to build. Here, the wire braces are being installed.

PHOTOS BY ALEXANDER MULLER

FLIGHT PERFORMANCE

I modeled my R/C plane on Jim Keller's full-size Super Stearman no. N68975. Until you see the bipe perform, the larger than specified engine—a 3W-120B2 Magnum—isn't obvious. This 7ci, in-line twin-cylinder, single-carburetor marvel turns a Menz 28x12 propeller at more than 6,000rpm and provides plenty of power. At a third or less throttle, the bipe purrs beautifully for low flybys. Turn the smoke on, and you'll hear the loudest "Oohs" and "Aahs" ever from the spectators.

• Takeoff and landing

When taxiing, take it easy and be sure not to make any abrupt turns, or you may scuff the bottom wingtips. Once lined up for takeoff, open the throttle slowly and let the airplane build up speed gradually until it lifts off. With practice, you will be able to allow the tail to come up for a few seconds before you apply the slightest up-elevator for a very scale, smooth takeoff. As you may expect, right rudder is required from the very beginning, but otherwise, takeoff is easy and straightforward. With the 3W engine, if you open the throttle all the way for takeoff, the big bipe will be airborne in a blink.

To land, once you've lined up the airplane with the runway, you can predictably and precisely control its rate of descent with the throttle. Bring it in with just a bit of power, feed in a hint of up-elevator for scarcely a flare to allow the mains to touch down slightly before the tail, and the bipe will settle down nicely. Remember that it likes to do ground loops, so once down, continue to control it closely and gently until it comes to a complete stop.

• Low-speed performance

The biplane does not have any undesirable surprises in store. It is very stable and essentially flies as you would expect a large R/C airplane to fly. At lower throttle settings, it flies and looks just like its full-scale counterpart. Low, slow flybys are a sight to behold, and because the airplane is so stable, they are easy to fly.

• High-speed performance

If you open the throttle and build up speed before entering maneuvers, you'll be able to make smooth, round figures. My Stearman did not require any trim adjustments.

• Aerobatics

Doing loops (inside or outside), avalanches and any of the figure-8 maneuvers requires throttle. The airplane snaps well, and you will notice that it starts the snap slowly and then accelerates briskly through the maneuver. You will have to experiment to determine which combination of rudder, elevator and perhaps ailerons you should use to obtain the snaps you want.

Remember, you have 50 pounds of airplane gaining momentum up there, so allow plenty of room for recovery. Just as on the full-size Super Stearman, the upper ailerons do speed up the roll rate, but it still is slower than the more aerobatic Lasers and Extras. Nevertheless, rolls are easy and very scale-like, and multiple rolls do not require undue down-elevator during the inverted portions. By the same token, inverted flight requires just a tad of down-elevator to keep the big bird on level flight. My Stearman flies knife-edge without a problem and doesn't show any tendency to fall off. Of course, the 3W powerplant plays a key role here. Keep in mind that with full or near full rudder, the airplane will tend to level itself, so you'll have to play with the ailerons and the elevator to keep it on edge and tracking straight, but this does not present much of a challenge. You may find that for some of the vertical maneuvers, such as hammerhead stall turns, keeping more power on than you would with other airplanes will work better.

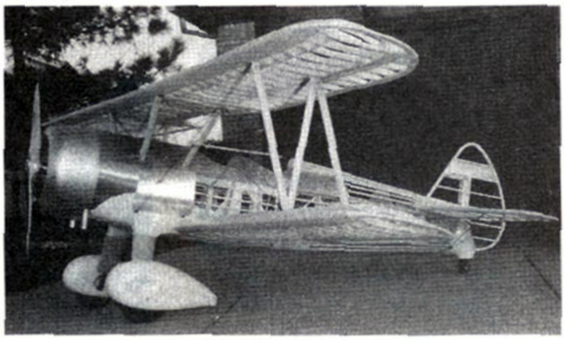
The locations of the lower wing attachment ribs are critical because they determine the incidence of the lower wings. Neither the instructions nor the drawings specify any of the incidences, but as closely as I could measure, both the upper and lower wings were designed with about 2 degrees of positive incidence.

All R/C biplanes I have seen have 1 or 2 degrees negative incidence for the upper wing and zero for the bottom wing (and for the horizontal stab), and this is how I built my Super Stearman. The differences between the incidences (negative on top and zero on the bottom) allow the upper wing to stall last and lets the airplane fly more slowly. Initially, I lightly tack-glued the attachment ribs, and I repositioned them later during final assembly.

When installing the longerons, cut (or recut) the slots on the formers as needed to make the longerons straight and parallel. With the longerons in place, the 1/32-inch-ply sheeting can be installed. Again, I followed the instructions and completed this without any problems. With all the plywood sheeting in place, it was time for the final installation and alignment of the wings and tail feathers.

ASSEMBLY AND ALIGNMENT

• **Wings.** To set and align the center section, I followed the instructions and positioned the leading edge as specified, but I raised the trailing edge ½ inch higher than the leading edge. This results in a negative incidence of about 1 degree. I also relocated the lower wing attachment ribs so that they would be at zero incidence. This meant keeping the leading edge as designed and raising the trailing edge to the same height as the leading edge.



The completed Stearman ready for covering.

Wing alignment, dihedral and incidence can be accurately set as follows:

• Draw centerlines on the root ribs and on several other ribs according to the rib centerline on the plans side-view drawing—sheet 1. (It is easier to draw these center lines on the ribs before the wings have been built.)

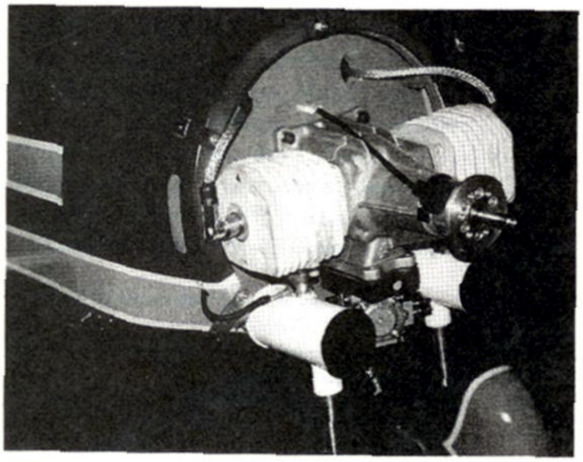
• Then support the fuselage so it is perfectly parallel with the work surface.

• Now measure from the work surface to the rib centerlines, and establish the incidences and alignments.

With 1½ degrees negative incidence on the top and zero on the lower wing and stab, my Stearman flies level and looks great. *[Editor's note: Balsa USA recommends the use of the setup shown on the plans and instruction manual.]*

• **Struts and braces.** The cabanes, X-braces and forward brace wires are some of the most challenging aspects of the kit, i.e., making, installing and adjusting the bracing, flying and landing wires. Take

your time; don't cut or braze anything until you are certain that you have everything figured out several steps ahead, and you won't have any regrets. Balsa USA has included everything you need to complete the airplane, but there are no spares. So unless you are ready to procure spare fittings, forks, wires, etc., be careful, and don't mess up!



The wonderful 3W-120B2 engine flies the Stearman with authority.

The way I adjusted the wires resulted in the last set installed having the fork holes about 1/8 inch away from their matching holes in the wire fittings. Thus, when the forks and fittings were drawn together, the entire assembly was snug and none of the wires rattled. To determine which assembly order worked best, I experimented with the flying and landing wires; regardless of the order in which they were assembled, the last set of wires was always difficult to assemble.

• **Tail feathers.** I finished and trimmed the horizontal stab mount on the fuselage to make the incidence zero; then I installed the horizontal and vertical stabs, the elevator halves and the rudder. Later, I mounted the two servos for the elevator halves and the servo for the rudder in the fuselage immediately aft of the rear cockpit. To gain access to these servos, I made a removable hatch in the bottom of the fuselage. The servos can now be reached from the top through the rear cockpit opening, and from the bottom through this hatch. I did not use the single servo for the elevator, so I did not use the supplied removable plastic ABS tail cone. Instead, I made this section out of balsa and beefed it up. I also added a dorsal deck/headrest, as found on the full-scale prototype. This full dorsal deck extends from the rear cockpit to the vertical fin. The deck was easy to build, and it noticeably improves the Stearman's looks.

• **Landing gear.** This has to be assembled with silver brazing rod or a regular rod, but not with solder. If you have the experience and the equipment to braze, you won't have any problems. If you don't, get someone either to do it for you or to help you, because there is no room for error. The assembled landing gear is installed after the engine mount rails have been put into place. At this point, it is wise either to install or at least to make provisions for the fuel tanks in this area. Don't wait till later.

• **Engine mount, thrusts and cowl.** I recessed the firewall to accept the longer 3W*-120B2 engine. I made the rails 1 5/8 inches shorter and cut a firewall perimeter ring out of 1/2-inch-thick plywood. I then installed the ring by positioning it over the recessed firewall in such a way that the ABS boot fits the ring as if nothing has been modified. I also made an engine-mount plate out of 1/2-inch-thick plywood and shimmed it to provide 2 degrees of right thrust and 1 degree of downthrust. I mounted the plate off-center on the firewall so that even with the right-thrust and downthrust inclinations, the prop hub is centered in the cowl opening.

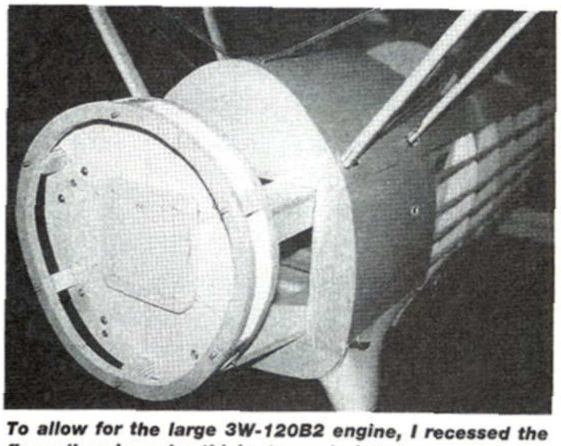
I installed the engine on the recessed firewall with its carburetor at the bottom. I mounted the ignition module on the back of the firewall and made two clearance holes for the spark-plug wires and one for the sensor wire. I cut out the ABS boot to allow clearance for the homemade mufflers, and I made two 1 1/2-inch holes on the cowl for the exhaust pipes. For better airflow, I added a baffle plate to the inside of the cowl. The baffle blocks the lower half of the cowl opening and directs the air to enter at the top, flow over and through the cylinder fins and exit through the bottom rear of the cowl. I cut out the center of the aluminum baffle plate and covered it with a sheet of clear plastic so that I'd be able to see into the lower engine compartment. A short piece of Nyrod operates the choke through a small hole on the bottom of the cowl.

I did not fasten the ABS plastic boot permanently to the fuselage as specified by the instructions. Instead, I used the screws that hold the cowl clips on the firewall ring to fasten the boot. On my Stearman, removing the boot allows access to the front of the tanks, to the ignition module and battery and to the smoke-system components. Both fuel tanks, by the way, are easily accessible through the front cockpit.

I used Nyrods to actuate the throttle and the smoke-pump switch. This allows me to position the servos well back and away from any potential sources of RF noise. In addition, the 3W ignition system, with its totally shielded cables and spark-plug caps, also minimizes the potential for interference. To duplicate the prototype, I made a cowl extension out of 0.032-inch-thick aluminum. This extension runs 7 inches behind the included cowl to about 1/8 inch in front of the cabanes.

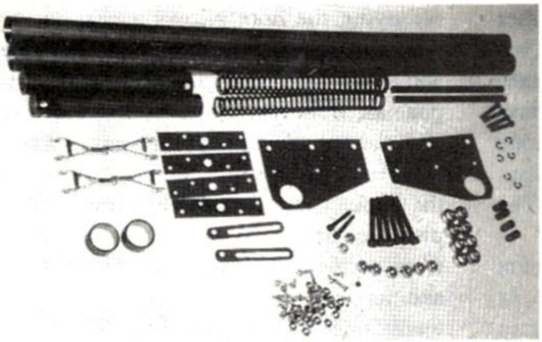
• **Finishing, etc.** I built a stand that supports the biplane by the engine mount and has an second vertical rest that supports the fuse just behind the rear cockpit. I made a pivot attachment that allows the biplane to be rotated about its axis and made positive stops every 90 degrees. I had intended to use the stand only for painting, but I used it for covering, painting and detailing.

To install the aluminum-sheet covering, I marked and drilled all the no. 56 holes for the 0x3/8 sheet-metal screws, but I initially installed only about a quarter of the screws because I knew they'd have to be removed before I covered the plane. I set the positions of the holes according to the full-size prototype, and this required more screws than supplied. Fortunately, Balsa USA sells them for a reasonable price.



To allow for the large 3W-120B2 engine, I recessed the firewall and used a thick plywood plate to establish the side thrust and downthrust. The engine is mounted slightly off-center to allow it to be centered in the cowl opening.

I used eight rolls of Balsa USA Solartex to cover the model and was pleased with the way it went on. It has also stayed tight (so far) even during many trips to the field in intense summer heat and sun. With the Solartex covering applied, I installed the



The landing gear must be assembled, and this requires brazing. If you can't do it, ask the help of someone who knows how.

aluminum sheeting with all the screws, and the Stearman was ready for painting.

I used Krylon spray paint: one coat of white primer and two coats of gloss white over the entire model, and then two or three coats of the Regal Blue and Cherry Red. I made the white stripes by masking off the gloss white so that it would show between the red and the blue.

• **Radio system.** I was rather concerned about the possibility that the combined wires (flying, landing and others) and aluminum sheeting would cause radio interference. Fortunately, I never had a problem. I use an Airtronics* Quasar radio and five Hitec* HS-700BB ¼-scale servos for the control surfaces and two standard servos for the throttle and the smoke. The longest leads, for the aileron servos, are 60 inches long, and I don't use a noise trap, a filter, or any other similar gadgets. I ran the antenna outside the fuselage, from just behind the top of the headrest to the vertical fin.

• **Weight, balance and other details.** My Stearman balanced at or very close to the recommended CG without any extra weight anywhere. It flies so well as it is that I neither need to nor am tempted to mess with the balance. My Stearman weighs 50½ pounds dry. With the 32-ounce and 24-ounce tanks full, the big bipe weighs less than the 55-pound AMA takeoff-weight limit.

AND FINALLY...

As well as being genuinely impressed and appreciative, when Jim Keller saw my R/C version of his Super Stearman, he pointed out that I had omitted a set of landing wires that are found on most full-scale Super Stearmans. Needless to say, I will install these extra wires on all the Super Stearmans I build in the future.

Other possible details include hand-holds at the lower wing's wingtips, air scoops and other accessories that you may see on some full-size prototypes. For up-close realism, you can add rib stitching and pinking tape, but they require considerable work, and this R/C jewel looks impressive without them.

In closing, I can sincerely say that this Stearman project was indeed challenging and very well worth the effort. The airplane is a joy to fly, and everyone loves it.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

About the author

Originally from Havana, Cuba, Alexander Muller came to the U.S. at the age of 15 and can't remember a time when he wasn't building model airplanes. He was involved with U-control for many years, and he started flying R/C eight years ago. For the last six years, he has specialized in giant-scale models. He says that R/C has helped him get through the tough times and that his greatest satisfaction is in passing on the fun and knowledge of the hobby to others.

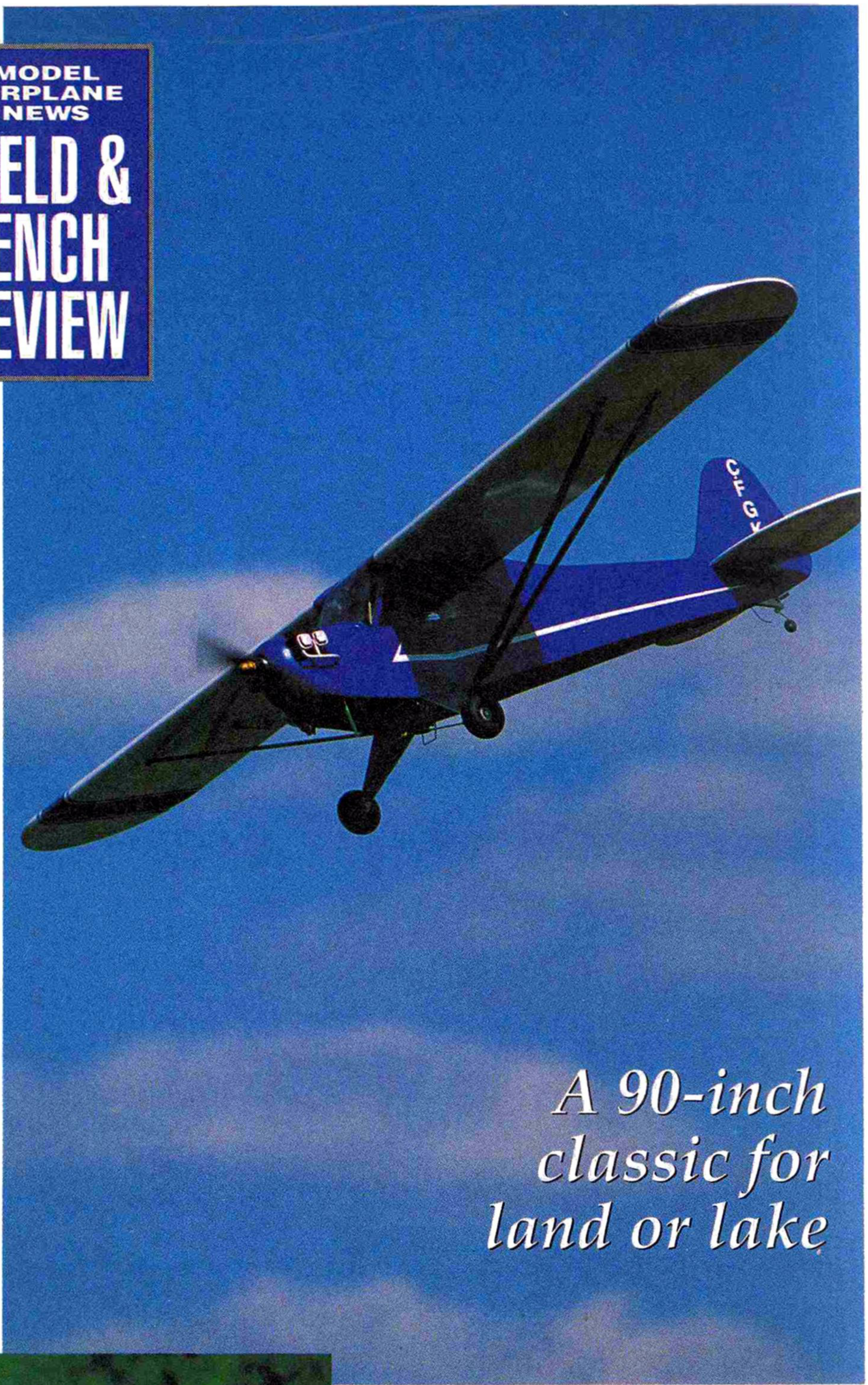
MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

GREAT PLANES Model Mfg. Co.* offers kits of the classic Piper J-3 Cub in three sizes: the .20, the .40 and the .60. Because I wanted to participate in some IMAA rallies, I chose the .60, which has a 90-inch wingspan. This Cub can be built with a standard-size wing, or it can be built with a clipped wing (83 inches) for better aerobatic performance. If you want a Cub on floats, Great Planes has a float kit for all three versions.

Great Planes .60 Piper Cub

by ROGER POST SR.



A 90-inch classic for land or lake

THE KIT

Its scale size is 1:4.7, and when it's complete, believe me, it's big. I had to lengthen my workbench to build the one-piece wing. The model is constructed of balsa and plywood, and the cowl is ABS plastic. There's quite of bit of wood in this kit, and with the exception of a couple of the die-cut balsa pieces being a little crunched, all the wood was in good shape. The lite-ply parts need very little finish-sanding before they can be used. The manual is well-written and easy to follow and has clear photos. Great Planes has included in the manual some expert tip sections, which provide very insightful hints. I found these quite valuable. The two sheets of plans are rolled and well-drawn, and a complete hardware package and formed windshield and windows are included to finish the plane. The entire kit was built using Great Planes epoxies and CAs. The bonding strength of these adhesives is amazing.

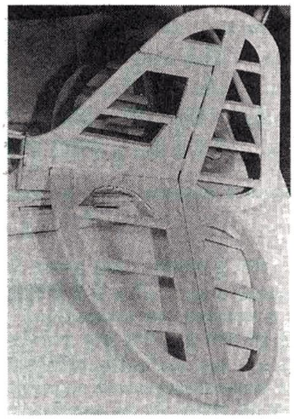
The author levitates the McDaniel R/C* Ni-Starter just before the first flight. For final balancing, a Harry Higley* heavy hub and lock nut were used.

CONSTRUCTION

• **Tail feathers.** The fin, stab, rudder and elevator are all built up right over the plans using die-cut parts and stock balsa. The stab's TE was about 1/8 inch short, so I built the stab to match it. The stab's outline was a little smaller than the plans indicated; this didn't seem to pose any problem, but before you attach the elevators, make sure that the LE of the connected elevators matches the stab's TE length. When the glue has dried, sand and shape the parts, hinge the control surfaces, and set them aside for later.

• **Wing/struts**. Set the parts over the plans, check for fit, and then glue them together. The wing is built in halves and then joined.

When I applied the bottom LE sheeting, I discovered that it was too wide. I had to cut 5/8 inch off the width of the sheeting to achieve the proper fit. I also made a couple of modifications. First, I added 6/32-inch blind nuts to the plywood blocks that are used to attach the wing struts. I then epoxied locknuts with plastic inserts over these to ensure that the strut-attachment bolts would not come out in flight. I used the same procedure for the strut attachments on the bottom of the fuselage.



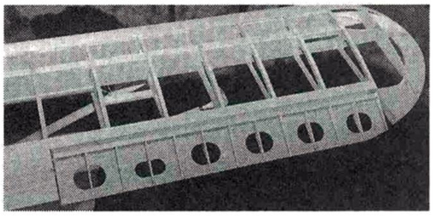
The completed tail surfaces are attached to the fuselage. The fin fairing blocks have been added as well.

The second modification was adding an extra piece to the wing joiner/dihedral brace. The wing joiner is made of three pieces (two long pieces, parts B, and one short piece, part A), but when you join them, they are 1/8 inch narrower than the spars that they go between. I added an extra 1/8-inch-wide short piece (part A) and solved the problem. I also added The Aeroplane Works* cardboard tubes to the inside of the wing; this allowed me to run the aileron extension wires effortlessly through the wing.

After the wing halves had been joined and the ailerons had been hinged, I filled and sanded the wing and set it aside for later.

• **Fuselage.** The fuselage's interlocking structure makes it extremely easy to build. Before using any glue, I assembled the main structure and checked the parts' fit. When the fuselage had been completed (no bottom sheeting or top dowel stringers yet), it was as straight as an arrow and quite strong. Besides the above-mentioned fuselage modification, I added two plywood blocks to the wing-bolt hold-down blocks. The supplied blocks didn't reach the top of the fuse, so I added a block to each wing-bolt hold-down area. This added

PHOTOS BY ROGER POST SR. & WALTER SIDAS



Like the wing, the aileron has a notched leading edge, and the piece that runs lengthwise fits into the groove that spans the length of the leading-edge piece. Make sure that the two main pieces are glued together at a right angle.

Flying the .20 Cub

Cubs are supposed to fly like Cubs, and with a .20 4-stroke engine (the minimum suggested for this model), this one needed to fly at reduced throttle to properly display full-scale performance. On the first flight, the airplane was a little tail-heavy and required a very light touch on the elevator to keep things within reason. Later, when 2 ounces had been added to the nose, it became the respectable airplane that exemplified its type. All flights were made with the wing struts in place simply because the plane looks so much better that way!

General flying is done at about 1/2 throttle. Control response is positive yet gentle, and the plane sits in the air well. The use of strip ailerons, rather than the barn-door type used on the full-scale Cub, smoothes out turns and rolls without making it necessary to coordinate rudder. The stall is rather gentle and straight ahead, and that makes 3-point landings very nice; simply hold it off, and it will settle onto the runway in a most pleasing manner. This is the kind of scale airplane you take to the field because it's fun to fly.

The instruction manual suggests that aerobatics be done without the wing struts, and there is probably some improvement in performance without them. With the struts in place, however, the loops are nice and round, but a shallow dive to pick up speed is necessary. Rolls are not the best, but with a little rudder help now and then, they actually look pretty good. About all that can be said for inverted flight is that

it can be maintained. All in all, if you want an aerobatic airplane, build the clipped-wing version, and keep it light.

Mounting the floats on the airplane is almost as easy as changing wheels. My only concern was that the floats added a full pound to the model, but the airplane skipped up on step and lifted off after a run of just a few yards more than the takeoff run with wheels!

READER'S REPORT
by RANDY RANDOLPH

SPECIFICATIONS .20 CUB

Model: Piper J-3 Cub .20

Type: sport plane

Manufacturer: Great Planes Model Mfg. Co.

Wingspan: 61 in. (full-wing version)

Wing area: 527 sq. in.

Weight: 54 oz.

Wing loading: 14.7 oz./sq. ft.

Length: 39 in.

Engine req'd: .15 to .25 2-stroke or .20 to .26 4-stroke

Radio req'd: 4-channel

Part no: GPMA0158

List price: $119.99

Features: die-cut balsa and plywood parts, formed-wire parts, clevises, hinges, balsa sheet and strips, formed leading and trailing edges, windshield, cowl, engine mount with hardware, control linkages, decals, rolled plans and an instruction manual.

Comments: this is a very good kit at a reasonable price, and the manual is thorough and well-written. This Cub is the kind of scale airplane you take to the field because it's fun to fly!

Hits
• Excellent die-cutting.
• Complete hardware package.
• Easy-to-follow instruction manual.
• Plastic parts fit as intended.
• Good value.

Misses
• Plans printed on both sides of plan sheet.
• A little on the heavy side.

by Roger Post Jr.

The Cub is powered by an O.S. .91 4-stroke with a Du-Bro Arise 4-stroke muffler and a 15x8 Master Airscrew. This combination yields a quiet 83.5dB!*

FLIGHT PERFORMANCE

• Takeoff and landing
Gradually apply throttle, and add some right rudder. When the tail comes up, increase speed (about 1/2 throttle was used for takeoff), apply a little backpressure, and the Cub will lift effortlessly off the ground. During the climb-out, hold some right rudder.

The Cub was leveled off and trimmed with some up-elevator and right aileron. With the suggested control-surface throws, rudder was fine, but I thought the ailerons and elevator were a little touchy for a Cub. When banking the plane for turns, you have to coordinate rudder and ailerons.

To land, line up with the runway, keep the wings level, and control the descent rate with the throttle and the airspeed with the elevator. Flare a few inches from the ground, and let the plane settle in. When making a 3-point landing, be ready to add throttle because the Cub will drop at the very last second. That extra burst of throttle will groove it in every time. For wheel landings, set the attitude, and control the descent with the throttle. On touchdown, chop the throttle, and let it coast down the runway while you control direction with the rudder.

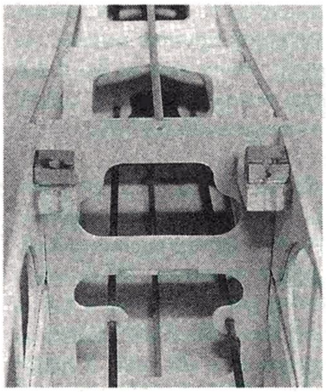
• Low-speed performance
Using 1/8 throttle, add some up-trim, and you'll achieve scale-like flight. For the power-off stall, set the throttle to idle and pull the elevator stick slowly back. The stall was so slight that slow, forward flight was barely interrupted. Gently release the elevator stick, add a little power, and the Cub continues to fly. If you fly the plane into a steep turn with the low power setting, add some power to avoid a stall/spin.

• High-speed performance
At full throttle, the Cub flies quickly. It's definitely unscale-like, but there's plenty of power for a good climb rate and aerobatics. For a power-on stall, set the throttle to about 2/3, and pull back on the stick. With a higher throttle setting, the Cub continues to climb. The power-on stall break is a little sharper and slightly to the left. Torque contributed to the left break, but with some right rudder, a straight-ahead stall can be achieved. To recover, release the backpressure, and let the Cub fly out of the stall.

• Aerobatics
A dive to increase speed helps to start a loop; the elevator has plenty of authority, so use it sparingly. There's plenty of power and rudder throw for wingovers and stall turns. The Cub rolled evenly both left and right with a little down-elevator added while inverted. Unlike its big brother, this Cub didn't spin with only rudder and elevator input. I had to use ailerons with rudder and up-elevator to achieve a spin. To recover, I released the sticks and applied some opposite rudder to stop the rotation. Cross-controlled flat turns and slips are easy, and the Cub will even fly inverted with slight forward stick added.

This Cub is a terrific flying airplane, and I look forward to flying it quite a bit; that's if Dad lets me borrow it.

strength to the wing-bolt blocks and brought them flush with the top of the fuselage. Next, I mounted the O.S.* .91 4-stroke engine, fuel tank, landing gear legs, pushrods and antenna-wire guide, and I trial-fitted the radio-gear tray. Now, the bottom sheeting, the rear float-gear block and the top of the fuse could be completed.



I added extra blocks to the wing-hold-down blocks. This made the surface of the blocks flush with the top edge of the fuselage.

• Assembly. This is where you really need some room. I raised and blocked the rear of the fuselage for zero thrust and placed the wing on it. I carefully measured the distance between each wingtip and the rear of the fuse, and when the distances matched, I drilled the holes for the wing hold-down bolts. Next, I trial-fitted the stabilizers, and when they were aligned, I glued them into place. The wing struts are preshaped, so very little sanding is required; glue the metal attachments to each end of the struts, and position them. Don't forget to make a

SPECIFICATIONS

Model: Piper J-3 Cub .60

Type: sport plane

Manufacturer: Great Planes Model Mfg. Co.

Wingspan: 90 in.; clipped-wing—83 in.

Wing area: 90-in. wing—1,123 sq. in.; clipped-wing—1,037 sq. in.

Weight: 9.5 to 12 lb. (review model—12 lb., 10 oz.)

Wing loading: 25.89 oz./sq. ft.

Length: 56½ in.

Engine req'd: .60 to .90 2-stroke or .70 to .91 4-stroke

Engine used: O.S. .91 4-stroke with Du-Bro Arise 4-stroke muffler

Prop used: Master Airscrew 15x8

Radio req'd: 4-channel (throttle, rudder, elevator, aileron); 5 channels if retractable water rudder is used

Radio used: JR 783 with NES-4000 servo on rudder; NES-4131 on elevator; two NES-7000s on ailerons; one NES-507 servo on throttle

Part no: GPMA0162

List price: $219 for the plane; $79 for the float kit

Features: precise-fitting CAD parts; can be built either clipped-wing or standard-wing; full-size rolled plans; formed, two-piece Dural landing gear; manual with step-by-step photos; good-quality, die-cut ply and balsa; preshaped leading edges and trailing edges with rib notches; complete hardware package; three-piece ABS cowl and dummy engine; decals; formed windshield and windows; preshaped wing struts with custom-molded fittings.

Comments: this IMAA-legal Cub was extremely easy to assemble and, overall, it's a nice kit. The one-piece, 90-inch wing is quite long, so make sure that it will fit in the vehicle that you drive to the flying field.

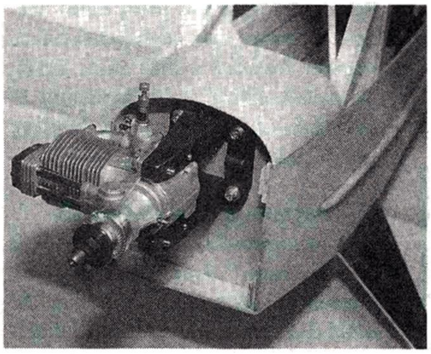
Hits
- Good-quality wood; die-cutting on the thin plywood is excellent.
- Clear, concise instruction manual with expert tips.
- Dual-servo aileron setup.
- Good flying characteristics; very gentle and stable.

Misses
- Some die-crunched parts in the tail surfaces.
- Bottom wing sheeting is too wide, but easy to fix.

right and left pair. I added pushrod exit pieces at this time and attached the elevator and rudder. Now the windshield and side windows could be fitted. When doing this, trim a little at a time; if you don't, you may cut too much away and create a gap between the window and the fuse attachment point. The three-piece cowl was assembled with CA and then cut out where necessary. For a scale-like appearance, I added the dummy engine. The seams were filled with putty and then sanded smooth.

I used a Williams Brothers* sport pilot figure that was painted by my wife. (All those art classes paid off because she did an excellent job.)

I used a Sullivan* tail-wheel assembly with a 1-inch wheel and Du-Bro* 4-inch



The O.S. .91 Surpass is attached with the supplied Great Planes motor mount. This engine will be cowled in, and a Du-Bro 4-stroke muffler will be used.

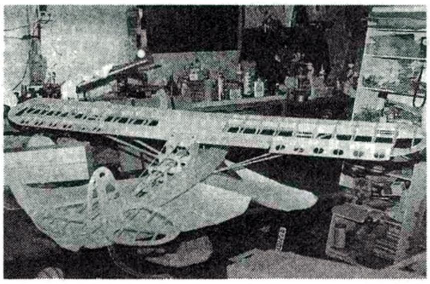
Cub main wheels for the landing-gear setup. I like the Sullivan tail gear for two reasons: it's strong, and it uses only a small wire (running along the bottom of the rudder) as an attachment point. You'll never break the rudder with this assembly.

• **Radio installation.** I used JR's* new 783 radio. The servos for the throttle, elevator and rudder are mounted in the servo tray, but this tray isn't permanently glued into place until the entire plane has been finished and covered. The tray can be slid fore and aft; this will help with the model's final balancing. I used two wing-mounted aileron servos and ran their extension wires through the cardboard tubes. The 1100mAh battery pack was placed under the tank, and the receiver was positioned directly behind the tank. The JR NES-480 locater beacon is directly behind the pilot figure's head; this placement allows the living pilot to see the locater's lights, which help him to determine the battery pack's remaining duration.

• **Covering.** Coverite's* 21st Century fabric looks and feels scale-like, and applying it is an absolute dream. Even if you have never used it before, you will achieve professional results on your first attempt. The spray paints that I used on the cowl closely matched the fabric. I used some Ironex to remove a little sticky residue that adhered to the finished covering. I used Bob Banka's Scale Model Research's* Foto-Paaks for my colors. Since I will eventually put this plane on floats, I chose one of Bob's three documented Cubs on floats, which was finished in a medium blue and white. When I finish the floats, they will be an aluminum color.

OVERVIEW

The kit is a pleasure to build, and it goes together rather quickly. But take some time on the detail work; it's well worth the effort, and it will produce a better and



Here's the Cub's frame completely assembled. As you can see, it takes up quite a bit of room, so plan your work space accordingly.

neater-looking model. For you scale buffs, with a little extra work, you'll have that scale Cub you've been looking for. And as with all Cubs, if they are built correctly, they fly beautifully. I'm looking forward to flying this one. Now I just need to figure out how I'm going to transport the one-piece, 90-inch wing. Have fun!

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

About the author

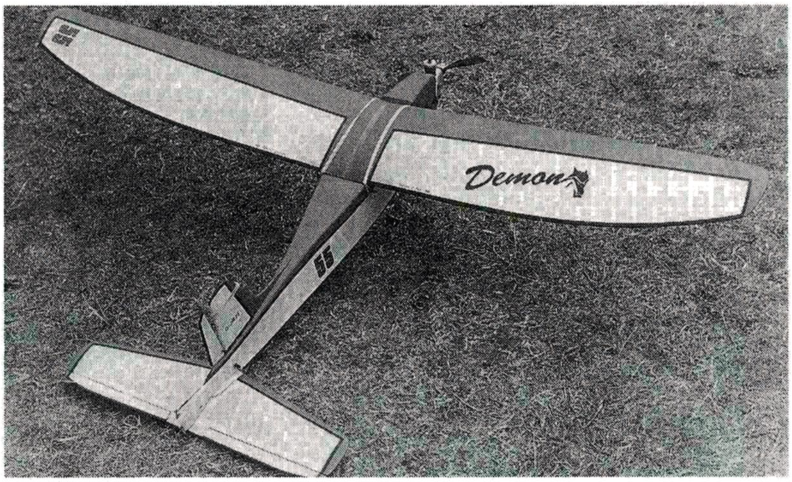
Since 1958, Roger Post Sr. has been involved in the R/C hobby. From huge transmitters that sat on the ground to the latest in computer radios, he has seen it all. He has built over 50 planes, including many 3- and 4-channel models and several electrics. He's retired from Southern New England Telephone and is trying to get in as much flying time as possible.

Golden AGE OF R/C

by HAL deBOLT

GORDON RAE'S DEMON

WE RECENTLY discussed some overseas OT R/C activity, which brought input once again from Gordon Rae of Worcester, England. Gordon is a first-class innovator who not only developed some unique, early R/C systems and models but also designs and constructs his own racing automobiles. Gordon's father, Harry, was also an ingenious sort and a fine craftsman; he constructed and further developed a twin model engine from castings when Gordon was still a lad. Gordon now treasures the engine as a memento of his father's work; because it still runs well, he plans to power a replica of an early design with it.



Gordon Rae's early '50s rudder-only Demon design features innovative rudder and elevator controls.

Another Englishman, Edgar Westbury, was the designer of this and other early model engines. He spread the word of his work through the *Model Engineer* publication. Gordon believes that it was Edgar who was the inspiration for the renowned engine designer Bill Atwood.

Is there a modeler who hasn't at one time or another used an Atwood engine? It would be a great task to list all the engines that Bill Atwood designed or manufactured. The story goes that Bill was intrigued by an engine article that Edgar had published, so he wrote to him for more information. Apparently, Edgar inspired Bill to delve into engines. As often happened in the early days, a mutual interest developed, and they corresponded steadily. Gordon indicates that along the way, their only real difference of opinion was on whether the "disk rotor valve" fuel induction favored by Edgar was the way to go; Bill preferred "shaft rotor" induction; this system was used in most Atwood engines. Hindsight would suggest that Bill may have believed the simplicity of shaft induction (especially from a manufacturing viewpoint) outweighed any superior performance of the disk rotor. Remember, this was early times and, until recently, most high-performance engines featured a disk rotor valve. No matter; this is another example of how early cooperation got us to where we are much more quickly!

DEMON DEVELOPMENTS

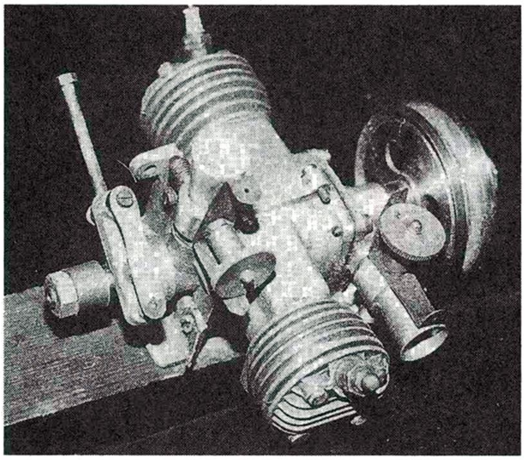
One of Gordon's early designs was the "Demon," which featured two innovations intended to overcome the limitations of single-channel, rudder-only control. If you attempted to turn with many rudder-only designs, you soon found that the nose dropped as you got into the turn. A makeshift solution, "beeping," meant applying short periods of control; i.e., you held the control on until nose drop was imminent, released the signal and applied control again after the model's stability had lifted the nose. Often, several "beeps" would be required to complete the desired turn without losing too much altitude. Recall that it required one signal application-and-hold to turn in one direction. For the other direction, the sequence was one application-and-hold, a release, then another quick signal-and-hold. As you can imagine, it required considerable dexterity with the TX signal button to

LOOKING FOR A FLYING FIELD?

Fran Ptaszkiewicz, the "Live Wire plan man," is another member of the early Flying Bisons who maintains his interest in model aviation. Fran wrote about the problems one club had in establishing a flying field. The Brauer Family Restaurant is in suburban Pendleton, NY, between Buffalo and Lockport. For many years, Brauers has furnished a meeting place for the Niagara County Model Club, which has a county-provided flying field. Along the way, another group formed and needed a flying facility. Brauers cordially offered suitable space behind the restaurant. Thus, the Brauers Aviators became a reality. Fran pointed this out as an example of cooperation between a business and modelers for the good of both. Have you noted similar possibilities as you've traveled your countryside?

accomplish a decent second turn!

Some designs attacked the "nose-drop syndrome" aerodynamically. For example, as with the Live Wire series, it was found that positioning the aft lateral area as low as possible delayed the advent of nose drop.



Harry Rae's homebuilt Westbury Twin from the '30s is still operable. Note the twin carburetors and ignition points in the rear.

Gordon worked on the problem with his Demon and arrived at this neat solution. He thought that the rudder might have some elevator action if it could be configured to create an upward longitudinal force as well as the desired yaw action. He rigged the rudder hinge so he could gradually tilt the hinge line back. After test flights, the angle was increased gradually; this was new territory! The result was that, with a 30-degree tilt, there was enough upward action to hold the nose level through a complete turn! Much later, Ed Kazmirski applied the same idea to his Taurus design to make tailspins more positive.

UPSIDE-DOWN?

Single-channel rudder-only allowed successful R/C flight and whetted our appetite for more than just steering. Gordon's desire was for inverted flight, which he accomplished mechanically with his Demon by using an elevator whose movement was controlled by a pendulum. The weighted lever was stopped with the elevator in correct position for upright flight. When the model was held inverted, the pendulum moved to another stop; this placed the elevator in the correct position for inverted flight. Gordon tells us he managed inverted flight by building up speed in a spiral dive; then with the excess speed, he performed a half loop. At the top of the loop, the pendulum swung to the inverted position, and the Demon flew inverted. All good things with the single control! He did not tell us about his trials and tribulations in perfecting these maneuvers and how he recovered from inverted flight!

Today, it can be hard to understand the desire the early birds had for more capability when the needed equipment had not yet been developed. A lot of midnight oil was burned as the pioneers struggled to innovate.

And so it was. Remember, this is *your* OT R/C column!

CITIZEN-SHIP 465 RADIO SYSTEM

Before about 1952, a Federal Communications Commission (FCC) license was required to fly R/C. The FCC had always allotted radio frequencies for specific purposes; fortunately, amateur radio (ham) operators had been assigned frequencies. To obtain the simplest ham license, however, you had to learn about electronics and be able to use Morse code. Early R/C'ers received ham licenses, but the knowledge requirements deterred the modeler types who would eventually swell the R/C ranks.

When the general public, including modelers, asked the FCC for an assigned frequency, the FCC allotted them 27.255MHz and 465MHz. Registration was all that was required. The result was a tremendous increase in the number of citizens-band ham operators, and the door opened for R/C as we know it!

The Citizen-Ship 465 system opened the R/C door to many non-electrical-type early modelers.

Vernon McNabb of Indianapolis, IN, who was in the electronics business, saw an opening in the R/C market with the new frequencies. He thought the CB'ers would concentrate on 27.255MHz, leaving 465MHz empty, so he organized the Citizen-Ship Radio Corp. to produce a radio system on 465MHz. The C-S 465 system was offered ready to use, while all others required some assembly and constant tuning. It made R/C success possible for many modelers, as shown when Gene Foxworthy won the Nats with his 465-equipped Hoosier Hot Shot.

The FCC at last slotted five spots on the 27MHz band for R/C-only use; this led Citizen-Ship into single-channel 27MHz systems, as was the trend. When reeds allowed multi-controls, C-S had a reed system. At this time, modelers were trying to obtain multi-control at a lower weight than was possible with reeds.

Dmeco Multi-Servos replaced escapement rubber power with electric motors. The M-S servos were much lighter than the reed types; with M-S servos, you could cut the reed system's weight at least by half. I then developed a 2-channel audio-tuned relay system that provided rudder and elevator on separate channels and engine control from the rudder's compound servo. McNabb saw the value of this and produced it commercially, albeit too late for the advancing market.

Citizen-Ship seemed to acquire a "me too" attitude and let others offer state-of-the-art equipment. It kept going into proportional times and then appeared to simply die on the vine. 'Twas good people, good stuff while it lasted, though!

Golden Era RACE PLANES

Designs ahead of their time

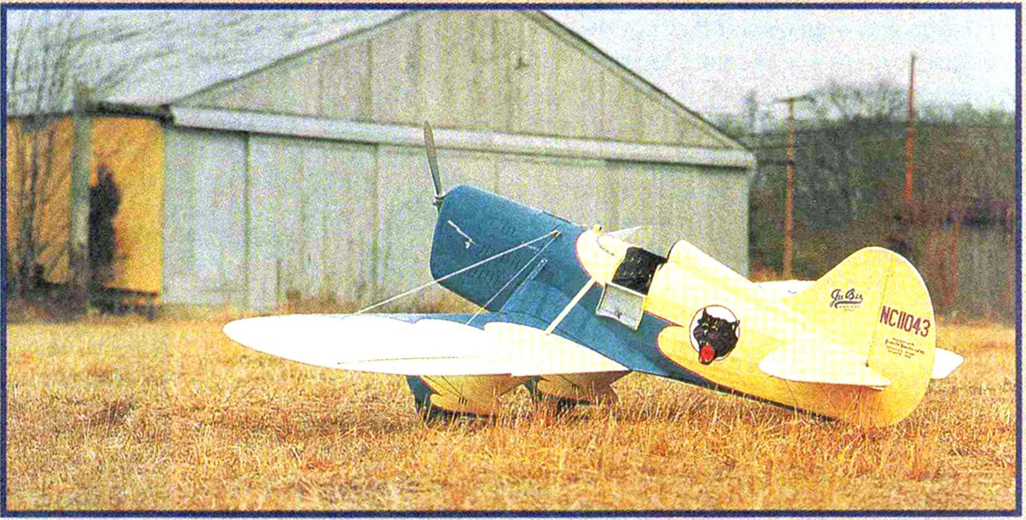
by HENRY HAFFKE

Having been born in Springfield, MA, where the fastest aircraft in the world were being built at the time apparently had an effect on my future. Many evenings, my father would drive my brothers and me to the Springfield Airport after supper to watch the airplanes fly. This was cheap entertainment when you didn't have 10¢ to go to a movie.

Henry (left) with Bob Granville (last of the five famous Granville brothers) holding his Model Y.

We lived less than a mile from the airport and enjoyed watching the airplanes fly. Actually, I was too young at the time to remember different airplanes unless there was something really special about them. I remember a big silver plane with three engines (a Ford Tri-Motor that Lowell Bayles used to fly there) and a blimp, but the others were just airplanes.

The time was right (1930 to 1935), so I had to have seen all the Gee Bees fly at one time or another. There's a well-known photo of the Gee Bee Model Z, which had just been rolled out for the onlookers to see. The photo was taken from out on the field and shows the spectators sitting on the park benches just outside the chainlink fence. It was taken in August, 1931, just before my fourth birthday. Looking carefully, I can see my father in the white golf hat that he always wore, and there are two young boys in front of him—my oldest brother and me.

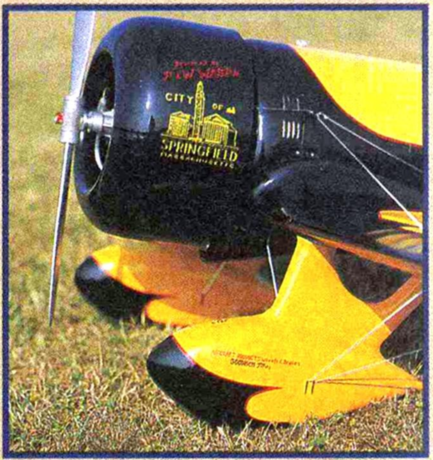


One-quarter-scale Gee Bee Model D.

Left to right: Maude Tait's Gee Bee Y, Florence Klingensmith's model Y, Art Chester's Jeep and Lowell Bayles' Gee Bee model X. These were Henry's early R/C race-plane models, built in the late 1970s.

STARTING YOUNG

Interest in aviation was instilled in me early, and I started building model airplanes at a very young age. My first projects were not very good; in fact, they were pretty bad. I was about 12 when I had my first successful flying model. It was from a 25¢ Comet kit of the Stinson SR-7. I built many models,



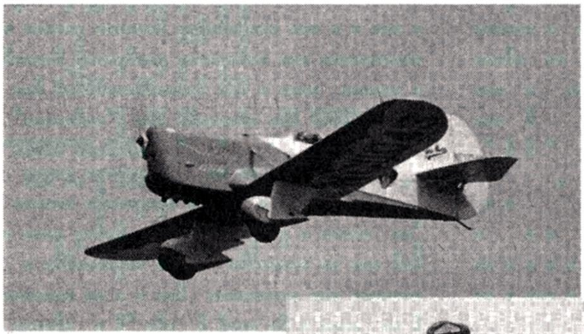
A close-up of a black-and-yellow 1/4-scale Gee Bee Model Z.

"I had the urge to build a model of one of the Gee Bee aircraft that were built close to my childhood home in Springfield. I chose a practically unknown aircraft that was built in 1930; I had seen only two very small photos of it in a profile publication on the Gee Bees."

Henry and the real Gee Bee Zeta's designer, Pete Miller, with the model.

and I built several of the 10¢ Comet Art Chester Jeep. I really liked the air racers that I read about in old model and aviation magazines.

I took my first airplane ride at the age of 15, in a 1939 Taylorcraft. I was hooked. A week or two later, I took my first lesson in that same airplane and soloed just a few days after my 16th birthday. By this time, I was building display models for a local store that sold model kits. I also built models of my instructor's Taylorcraft and Cub Cruiser; they each earned me 1 hour of flying time.



One-quarter-scale Gee Bee Model D in flight at Bealton, VA. (Photo by John Preston.)

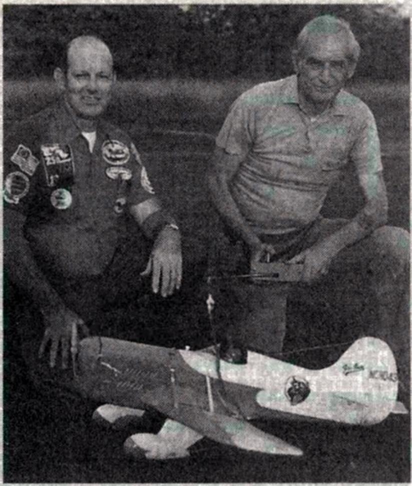
Joe Gallagher and his model of Time Flies from Henry's plans.

GETTING SERIOUS

I went into the Navy, where I became an aviation ordnance man and aerial gunner. I was getting much better at making good-looking models. I began to build engine-powered models, and after the War, when I was discharged, I competed successfully in control-line (CL) scale events in New England. Then I became interested in R/C flying, and after a few trainers, I decided to fly in scale events. I chose to model Art Chester's Jeep (I had designed one that I flew in CL scale). I designed a model of it and came in second in my first attempt at contest flying.

When I had improved, I designed a model of another of my favorite racers—Benny Howard's Ike. (A construction article on the model appeared in the April 1979 issue of *Model Airplane News.*) For years, the model consistently won in R/C scale events. Then I had the urge to build a model of one of the Gee Bee aircraft that were built close to my childhood home in Springfield. I chose a practically unknown aircraft that was built in 1930; I had seen only two very small photos of it in a profile publication on the Gee Bees. I found a set of 3-views and scaled up a .40-powered, 56-inch-span model; it was the best flying model I had ever flown.

When I began the project, I had very little documentation on it and searched for more. This led me to Bob Granville, and we became very good friends. He put me



Henry (left) with Bobby Granville, Zantford Granville's son, after Bobby flew Henry's Model D. The model had been flown for several years and, after having been flown by a Granville, it was retired "with high honors."

Granville Family

Bob Granville was so tickled that someone had built a Gee Bee and was flying it in contests that his interest in what he and his four brothers had done in the aviation field in the early 1930s was rekindled. He had worked on F4U Corsairs at Sikorsky in Connecticut during the war and then retired to Maine. When I met him, he had been away from aviation for more than 35 years. He joined me at several model meets and acted as my caller. It was a great experience for me to fly a model of a Gee Bee aircraft and have one of the Granville brothers there acting as my caller.

I continued to design and build other model Gee Bees, and I became very good friends with Zantford Granville's daughter, Norma, and her brother, Bobby (who was named after his uncle). Bobby was an excellent R/C pilot and competed in racing events.

In Springfield, at a Gee Bee celebration that commemorated the 50th Anniversary of the Gee Bee Company, an R/C flying event was set up by Don Foster (Gee Bee Models), and I flew my Model D Sportster. Don flew it, and then Bobby Granville flew it. The model had many flights on it, so after a Granville flew it, it was retired with high honors and never flown again.

The Granvilles are super people. They all helped to supply me with photos and information and put me in touch with owners and others who were involved with Gee Bee aircraft. After 15 years of research, their help enabled me to write a true history of the Granville brothers and the great aircraft they designed and built.

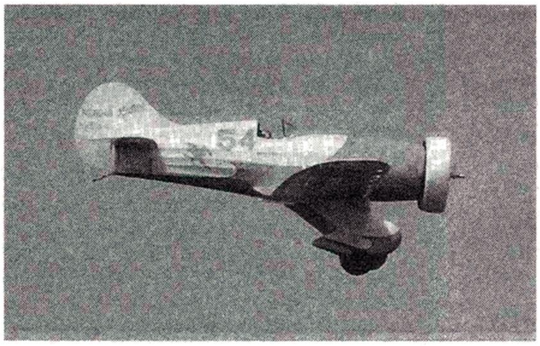
While I was writing this article, I heard of the death of Pete Miller (94). Pete designed the Gee Bee R-1 and R-2, the Zeta Aerobell and other unique craft. He was a great friend who gave me invaluable information about the Granville brothers.

in touch with his brother, Edward. From the two of them, I obtained many good photos of the Model Y, and with this documentation, my model became a frequent winner at scale meets. I flew it in my first Nationals in Dayton, OH, and finished in the top 10 in a very large field of scale models. Pictures of my model appeared in every model magazine, and their captions all commented on how well the model flew despite its being a Gee Bee! (As if it weren't supposed to fly because it had the Gee Bee logo on the fin!)

One-fifth-scale model of Ken Flaglor's Gee Bee Model Y replica at the 1985 Westover Nationals; the model achieved the meet's highest static score of 97.

SUCCESSFUL MODELS

I continued to build Gee Bee models and found that they all flew really well when built properly. The Sportsters are all fine flying subjects that almost any sport flier can handle. The racers—R-1, R-2, R-1/R-2—and the Model Z must be built to a large scale and kept light. My ¼-scale R-1 is a super flying model at 15 pounds. Many have been built from my plans, and the builders have told me that even at 16 and 17 pounds (and even a few at 18 pounds), the R-1 flies well. At heavier weights, it becomes a real handful that only the most proficient pilots can fly.

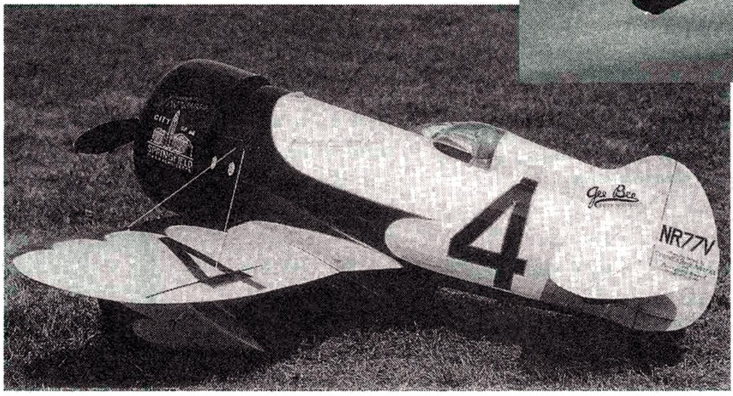


One-quarter-scale Gee Bee Model Y on a low flyby.

I had two good friends in my model club—the South Jersey R/C Society—who were big boosts to me and who got involved with the Gee Bees. One was Joe Gallagher—a supreme craftsman, who built four contest-winning Gee Bees from my plans. His first was a Model Y from my first Gee Bee plan. For a reference, I lent him my model while he was building his, and I told him how to make his better. He listened well and, afterward, he usually beat me in contests. Then he built a Gee Bee Zeta (a Gee Bee not many know about) and, later, a model of Frank Hawks' Time Flies (yes, it was also a Gee Bee and was featured in a *Model Airplane News* construction article in the July and August 1985 issues) and, finally, a ¼-scale Model E Sportster. Over the course of several years, Joe won many contests with these Gee Bee models.

My other close friend was Sid Clement, whom I believe is one of the best R/C pilots in the country. He has always helped me to get my engines to run at top performance and to keep my radios checked. Because he not only test-flew every one of my new model designs, but he also tested almost everyone else's new models all over the southern part of the state and into eastern Pennsylvania, he became known as the "South Jersey Test Pilot Supreme." Sid could take a new model up and fly a couple of circuits around the field, land and tell you the model needed a couple of turns on the aileron clevis or a turn-and-a-half of down-elevator, and on the next flight, it would fly perfectly trimmed.

Joe, Sid and I attended many scale meets together. Our favorites were those at Rhinebeck, NY, and the big Bealton, VA, scale meet. Both were held at airports that were filled with old-time nostalgia.

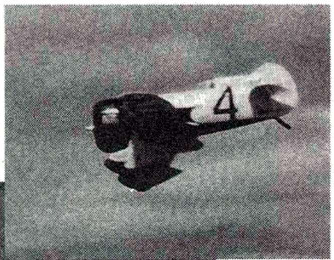


Side view of a ¼-scale Gee Bee model Z.

THE GEE BEE TEAM

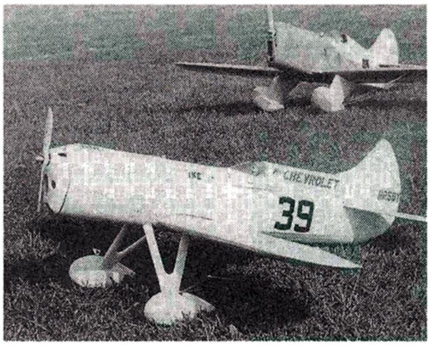
The first year of the Golden Era meet at Rhinebeck, Bob Granville was with me as I flew my Gee Bee Y and Model D Sportsters. I enjoyed introducing Bob to many of my modeling friends, one of whom was Art Schroeder, editor of *Model Airplane News* at the time. He took a picture of Bob and me with one of my models, and a few days after the meet, he called me at work to verify that the person I introduced him to was a real Granville brother (Art knew it was, but his publisher didn't believe it could be a real Granville.) I assured the publisher that it was indeed Bob Granville, one of the five famous brothers who designed and built the Gee Bees in the early 1930s.

My friend Sid didn't build scale models, but he enjoyed flying mine and Joe's in team-scale events. We flew for many years at the Bealton meet where Sid had flown my Ike. Then I built the R-1 and, later, the Model Z, both of which he flew in the team-scale event, and every year, we won the event at Bealton. It was great fun flying together as the "Gee Bee Team"—flying various models of Gee Bee aircraft year after year.



One-quarter-scale Gee Bee Model Z. (Flight shot by John Preston.)

Over the years, I've built many models of "golden era"



Benny Howard's Ike with a 1/4-scale Gee Bee D in back. (Ike is close to 1/4 scale.)

race planes, and they make great flying models. A lot of the golden-era racers were very aerobatic and were flown extensively in airshows. Benny Howard's Ike was an excellent aerobatic ship, and correspondence with Harold Neuman enlightened me on just how aerobatic it was. Harold owned the Ike for a while and flew it in the national airshows. He gave me his complete airshow routine so that I could fly a documented scale flight with my Ike. He also told me some funny stories about mishaps during performances as pilots would try to outdo one another. He said that it was great for airshows.

Also a little-known fact was that the Gee Bee Model Y won the national aerobatic title during the Omaha races in 1932. All of the Gee Bee Sportsters and Senior Sportsters were flown extensively in airshows and were excellent aerobatic aircraft.

GEE BEE FOR THE '90s

Today, with his exact replica of the Gee Bee R-2, Delmar Benjamin is showing everyone that even the Super Sportsters are excellent aerobats. He believes that the problem in the early 1930s was that pilots didn't have any experience in high-performance planes. The high-performance Gee Bee Super Sportsters were 60 years ahead of their time. I'm sure that many of you readers have had the chance to see Delmar fly his Gee Bee, and you were undoubtedly amazed at what he does with it. Those of you who haven't seen him fly should make every effort to attend one of his performances; they're a real treat.

So if you like the looks of any of the great golden-era air racers, don't hesitate to build a model. You may end up, as I did, with the best flying model you've ever flown.

Scratch-Builders' CORNER

by GEORGE WILSON JR.

GETTING STARTED

YOU'RE READING this column, so it's probably safe to assume that you're a scratch-builder or you want to try it. It can be less expensive than kit building, and it's certainly more conducive to using your own designs and construction techniques. Kits are much improved and include detailed instructions that make them easy to build, but with the information that follows, you should be able to get into scratch-building from plans and even to improve your kit building.

THE ADVANTAGES

When comparing the cost of building from scratch and building a kit bear these points in mind:

• Compare the cost of the kit to what its components would cost if bought separately.

• Remember that your scrap supply will benefit from any leftovers you may have. It's difficult to buy just one nose wheel at a hobby shop, but an extra wheel will go into your scrap box for a later project.

• When you buy wood or hardware, economize by buying "bundle deals."

• When scratch-building, you can select the balsa and hardware you really want.

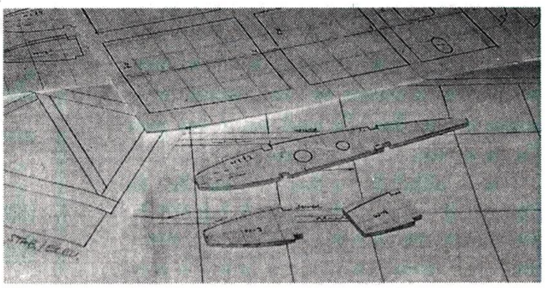
George poses with his OV-10 Bronco built from Model Airplane News plans FSP11951. George shows how to start your next project.

SCRATCH PROJECT

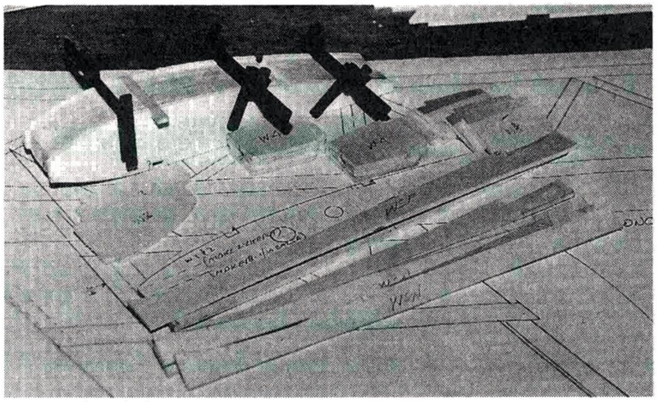
I enjoyed Rich Uravitch's presentation of the OV-10 Bronco in the November 1995 issue of *Model Airplane News* (plan no. FSP11951). Love at first sight turned into a request for the plans and the purchase of Rich's plastic parts for the Bronco. With this column in mind, during the initial building stages, I took photographs and made notes. Although the information given here is specifically about the Bronco, it's applicable to most scratch-built projects.

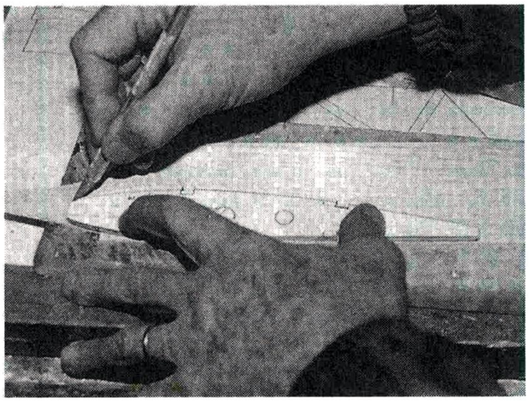
With the Bronco, I first studied the article and the small plan that it includes. If you want to build from other plans without the benefit of an article and its instructions, but you have a little experience, this shouldn't be a big problem unless the design includes exotic building techniques. Your initial study should reveal what you'll have to do to produce the model: construction techniques, covering and finishing, engine or motor and R/C requirements. With the full-size plans in hand, the study should get more definitive.

Most of us like to modify a design; I try to make my models easier to fly; at my old age, I'm not always ahead of today's fast and aerobatic designs, so I decided to modify the Bronco to slow it down. I increased its wing area (as suggested on the plan) and gave it a thicker, more blunt-nosed airfoil. I decided to increase the wingspan to $57^{1}/_{2}$ inches (instead of 52



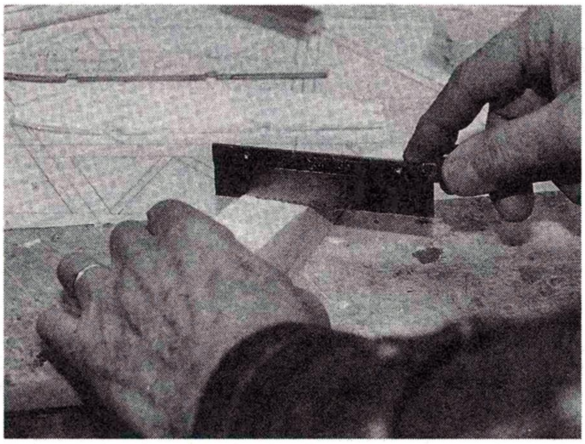
The wing-rib templates are cut following tracings of the rib drawing(s); then they're mounted on thin plywood or another material such as thin plastic or metal. Note the tracings (actually photocopies of the tracings) of one- or two-of-a-kind parts in the background. In these cases, the tracings/copies will be cut out and tack-glued to the material that will become the finished part, and the part will then be cut out.



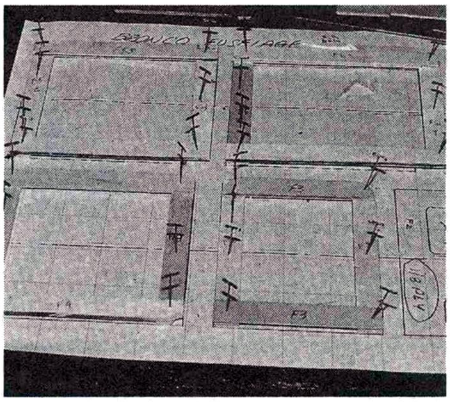


PHOTOS BY GEORGE WILSON JR.

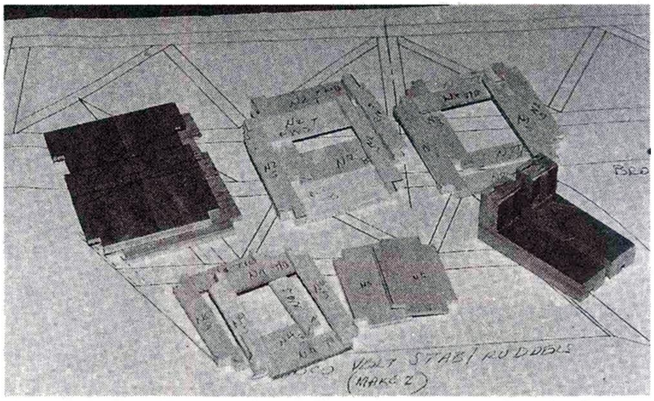
Left: here are some one- and two-of-a-kind parts and a stack of wing ribs. The parts you make for your "kit" should be ready to be glued into place. Notches, slots, etc., should be cut beforehand to facilitate assembly. Right: the wing ribs may be cut out in several ways. Slicing them out of sheet (as shown here) may seem old-fashioned, but it is relatively fast considering the time needed to stack blanks and saw or rout them. Use a sharp no. 11 blade, position the template to conserve material, and the job will soon be done.



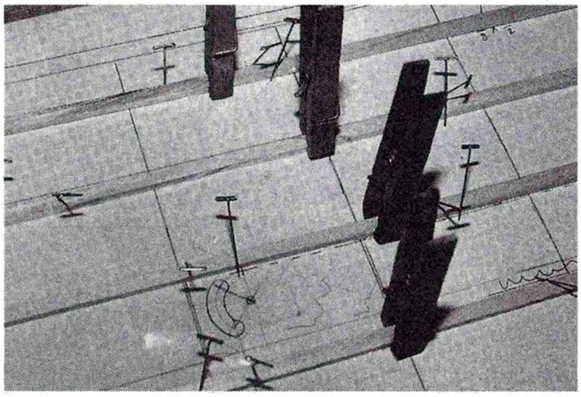
To notch the wing spars for the ribs, use a razor saw to cut the sides and a no. 11 blade to cut the bottoms. To keep them aligned, put a short piece of spar material into the notches of the stacked ribs, and then sand the entire stack to make them smooth and identical.



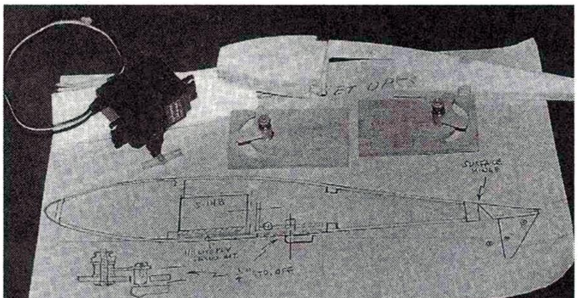
To save material and weight, the bulkheads for square fuselages may be built up as shown in this photo. These bulkheads are made of 1/8-inch lite-ply.



These bulkheads, firewalls and gear mounts are for the Bronco nacelles. They have been assembled and are ready to be installed.



Small models—spans less than 6 feet and no dihedral—present no problem for the one-piece spars, leading edges (LEs) or trailing edges (TEs). The Bronco has no dihedral. Continuous spars, LEs and TEs are the proper way to go. These pieces may be spliced using diagonal (scarf) splices. The length of the splice should be several times the thickness of the wood being joined. When using spliced pieces, avoid installing them in such a way that two splices are opposite each other, because this weakens the assembly.



Several parts involved in the aileron control system are shown here, as is the layout of the aileron control system's essential dimensions. Layouts of this sort ensure that things will fit properly and have the necessary clearances.

inches) and if weight can be minimized, the wing loading will be reasonably low, and the Bronco will fly slowly enough to allow me to keep ahead of it.

Additionally, I simplified the wire nose-gear strut to make it more conventional. (Bending 5/32-inch music wire is not easy.) At first, I thought I'd have to adapt the nacelles to fit my choice of engines, but Rich's plastic cowls are longer than those shown on the plans and will work well with the K&B* Sportster .25s that I plan to use.

To minimize weight, my wing spars were changed to 1/4x1/8-inch spruce (not 1/4-inch-square balsa), and I added additional 1/4x1/8-inch spruce wing-center stiffeners at the forward spar.

These changes are personal preferences and are not criticisms of Rich's design.

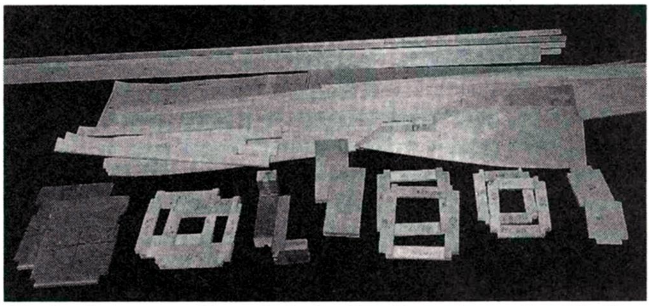
• **Plans.** I don't build over the plans. I trace the formers, ribs, wingtips, doublers, fuselage, nacelle sides and the other pieces to be cut out of sheet stock and then photocopy them to provide the templates used to make the various parts. I cut out the copied part outlines and then tack-glue them to the sheet stock before I cut the wood.

Re-draw the wing and tail-surface layouts to show only the lines needed to build on. In the case of wings, you need only the main spar and rib locations. When you build over plans, the details are soon covered by wood, and some of these details may be needed during construction. Again, the tail surfaces need little to guide the construction: the spar (frequently just the leading- and trailing-edge positions) and rib positions are adequate. Fuselages (and the Bronco's nacelles) are built over a centerline with the former/bulkhead locations drawn across it. Don't forget to cover the "plan" with wax paper or plastic kitchen wrap to prevent the structures from sticking to the paper.

Re-drawing the plans has at least two other virtues: you gain a more intimate knowledge of the construction; you'll find any errors that exist in the original. Thanks to their manufacturers' production engineering and their desire to produce a good product and promote future sales, kit plans are usually accu-

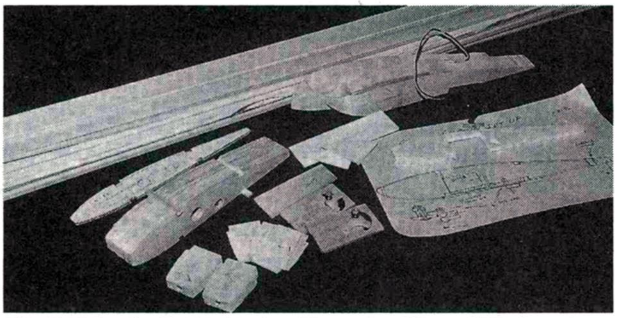
rate; magazine plans that have been re-drawn and/or inked by expert draftsmen like Joe Demarco are usually very good; but plans by scratch designers who are not expert draftsmen may include flaws. Plans are often corrected after the plane has been built and flight-tested; sometimes, they don't need to be.

The Bronco plan has some problems that work themselves out if you re-draw them as recommended previously. Check the fuselage and nacelle bulkhead widths, heights and centerlines and correct them as necessary. The heights should be compared with the side views; F3 through F6 and N1 and N2 are of the same widths. The nacelles' rear sides are essentially flat from N4 to the aft end; N3 is slightly narrower than N1 and N2 to allow a slight bend that fairs the front and rear flat surfaces together. Top views of the fuselage and nacelles would have been helpful. (I drew them myself to check out the bulkhead widths.) The WS/WSN wing saddle doublers are of $^1/_8$-inch lite-ply. The wing trailing edge (TE) is $^1/_2$x1$^1/_2$-inch TE stock not the $^3/_8$x1$^1/_2$-inch stock called for on the plan. The vertical-fin top pattern (FT) should be changed to fit the fin's rear upright. (Note that one of the fuselage formers is also marked "FT.")

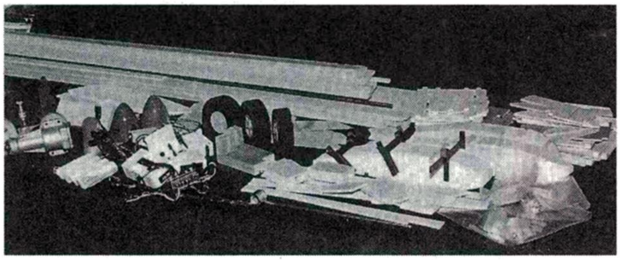


Here's what you need to make both of the Bronco's nacelles. Like the fuselage, they're square, so they're easy to assemble over a center-line on which the bulkhead locations have been marked.

• **Kitting.** When you scratch-build, it is best to "kit" the parts before you start assembly. It will save a great deal of time during construction. Your kit should have at least as many parts as a good equivalent commercial kit. In addition to the cutout sheet-wood parts—ribs, formers/bulkheads, fuselage sides, doublers, dihedral braces, etc.—gather the motor/engines and muffler, R/C system and miscellaneous hardware. The following checklist is, in part, from an Indy R/C* sales catalogue:



The "kit" for the Bronco's wing. The spars, LEs and TEs have been scarf-spliced and are continuous from wingtip to wingtip.



Everything you need to make a Bronco—an impressive collection of wooden parts and hardware. At this point, you're ready to start assembly.

CHECKLIST
- Motor mount(s)
- Rubber bands/nylon bolts
- Propeller
- Bellcranks
- Spinner/prop nut
- Wing-bedding tape
- Tank/fuel lines
- Hinges
- Gear struts
- Pushrods
- Wheels/collars
- Control horns
- Tail-wheel or nose-wheel mount
- Clevises

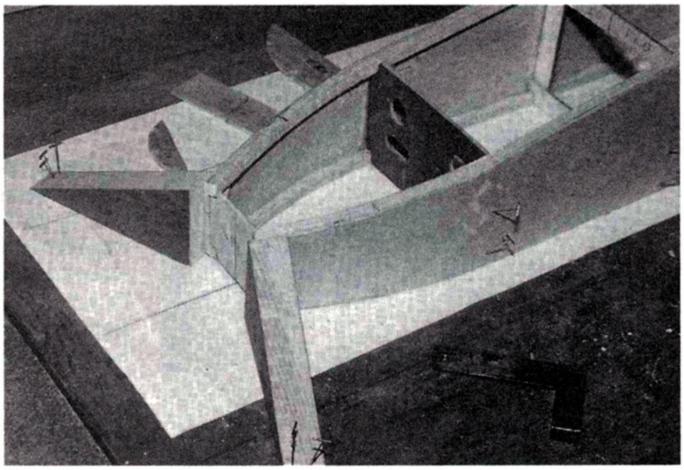
Check out your scrap box and then visit your hobby shop or prepare a mail order. Select balsa to fit its use; my scrap box and storage shelves often provide just what I need. At times, pieces may have to be joined to arrive at the proper sizes.

Ribs can be quickly cut out using a plywood (or similar) template and cutting them out of balsa sheet using a hobby knife (no. 11 or similar). Stack, sand and notch the ribs using a razor saw. The ribs will be ready before you know it.

You can also make ribs in these ways:
• Stack blanks and cut the stack with a band saw or a jigsaw. Make sure the blade is at a right angle to the saw table.
• Cut a block of balsa to the rib shape, and slice the ribs off the block using a saw.
• Use a template and a router.

I have tried all three of these methods, but almost always follow the old-fashioned way: I cut them out individually with a blade. It is not as time-consuming as you may think.

So start by getting all the parts ready for assembly, but when you scratch-build, you are not just assembling parts: you are selecting materials and making design changes. You are in charge!



The parts for the partially assembled fuselage front end are held in place by scratch-built squares made with $^3/_4$-inch pine. Its thickness makes this type of square easy to work with, and it may be pinned into place.

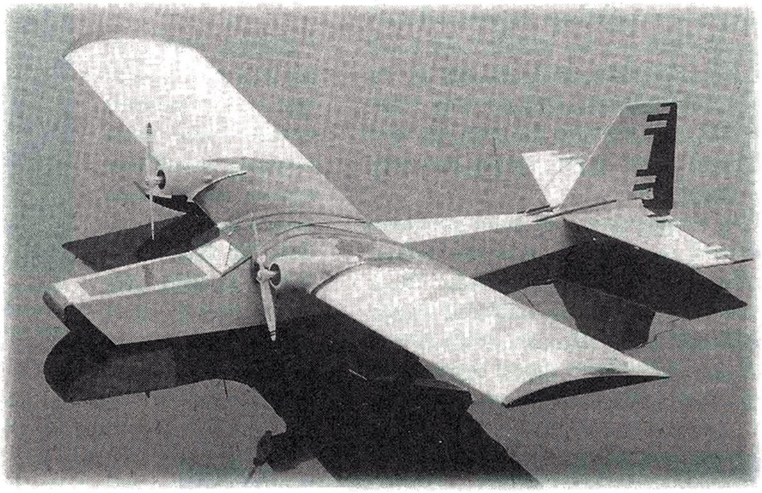
**Manufacturers are listed alphabetically in the Index of Manufacturers on page 110.*

MODEL AIRPLANE NEWS
HOW TO

An easy and inexpensive alternative to fiberglass and resin

HERE'S A TECHNIQUE worth considering the next time you need a special shape for a cowl, nacelle, radome, turtle deck, or fairing. The result is light, easy to work with and costs practically nothing! All you need is newspaper, Titebond II glue and a mold form shaped out of scrap wood. The process is similar to fiberglassing but you use newspaper and glue instead of glass cloth and epoxy. It is also a useful technique for producing complex shapes that can't easily be made by vacuum-forming.

The cowl and the nacelles on my PuddleMaster have distinctive shapes; forming each requires a different approach, especially in the layup process. The following description shows you how to lay up most shapes. You may need to experiment when you cut the paper laminations, but then newsprint is cheap.

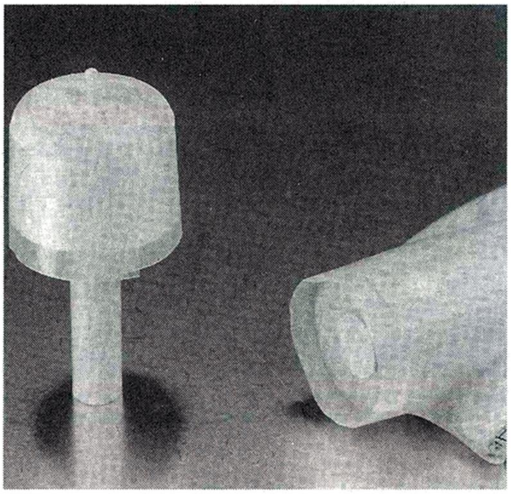


PHOTOS BY HARRY B. CORDES

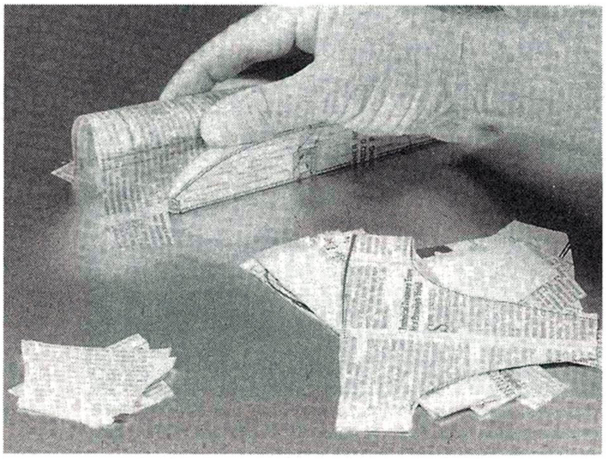
Make Laminated Paper Parts

by HARRY B. CORDES

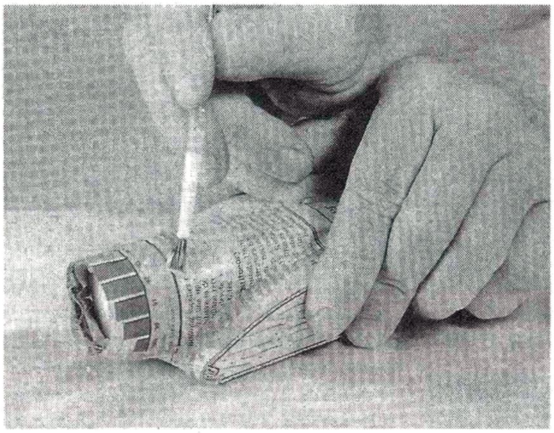
1 First, make the layup forms. I made the nacelle form $1/4$ inch larger in diameter than my motor's outside diameter (o.d.) to allow cooling air to flow around it. To allow the finished layups to slide off, I tapered the front of the nacelle form about 3 degrees, then glued it to a wooden wing form and faired it into the wing using wood putty. I made the cowl form $3/32$ inch larger in diameter than the nacelle to allow for the build-up in the nacelle's wall thickness; I also tapered it so the finished cowl would be removable. The $1/8$-inch-diameter dowel in the front of the cowl form holds the paper laminations in place during the layup process; it also centers a guide washer for cutting out the center of the finished cowl. To seal the grain, I gave the forms two coats of shellac, fine-sanded them and finished them with a heavy coat of paste wax.



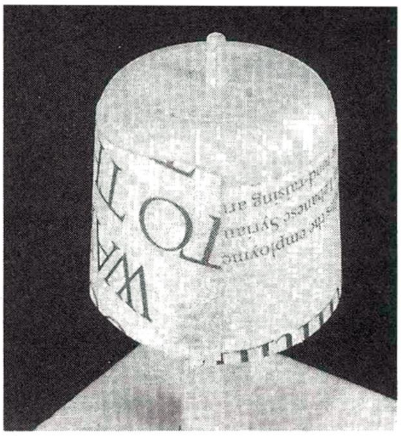
2 Next, I applied a layer of wax paper around the cowl and the front of the nacelle—held in place with a dab of paste wax—as added insurance that the layups would be easy to release from the forms.



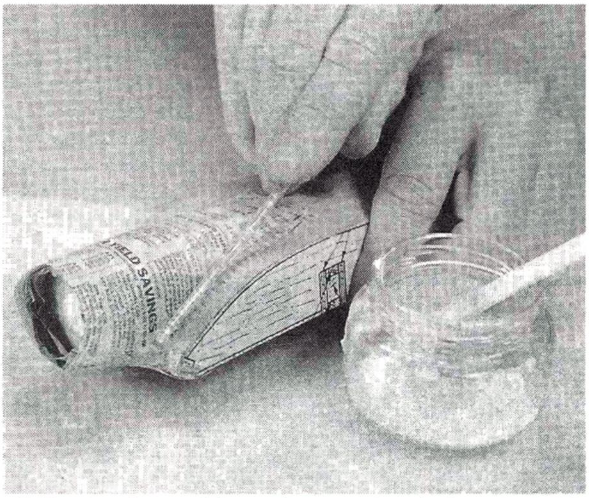
3 Before laying up the nacelle, I experimented with several different paper shapes to find the best fit for the contour. The two shapes shown worked nicely. The larger one wrapped completely around the nacelle; when it was wetted, I was able to work it into the wing/nacelle fillet with minimum tearing. (Some tearing is tolerable as long as the tears in one layer do not overlap those in the next. Reinforce torn areas with interleaved paper patches or strips.) The smaller shape covers the lower side where the nacelle is faired over the leading edge of the wing. Because the finished part is trimmed to size after the layup has cured, I cut the shapes oversize.



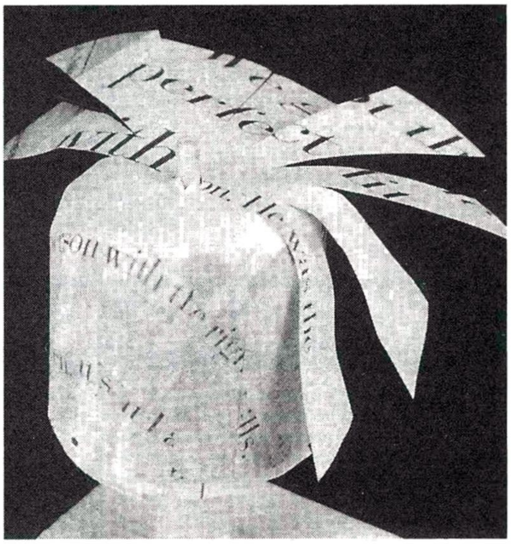
4 To laminate the nacelle form, I soaked a layer of paper in water and smoothed it into place, covering the form on the top and bottom. Next, I liberally applied a 50/50 mix of Titebond II glue and water to the still-damp surface of the first layer. Then, I put the second layer into place to dry. The fresh glue below permeated the second layer and made it more pliable as it was smoothed on.



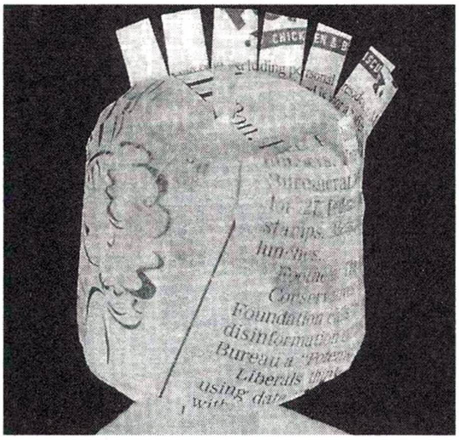
5 A round plastic rod or an artist's brush handle makes a good tool to work into fillet areas and to burnish wrinkles. With another layer of glue mixture on the second layer, I applied the third layer (again, dry). Continue this process until you reach the final layup thickness. I used six layers on the nacelle to get a buildup of about 0.04 inch. After adding each layer, work it tightly to the form and to the other layers so that air won't be trapped between them; burnish wrinkles as much as possible. Make sure all overlaps are covered with glue, and stagger overlaps to obtain a reasonably uniform thickness. Reinforce tears with patches as required. After you've smoothed the final layer into place, apply a final coating of glue, and set the work aside to dry and cure.



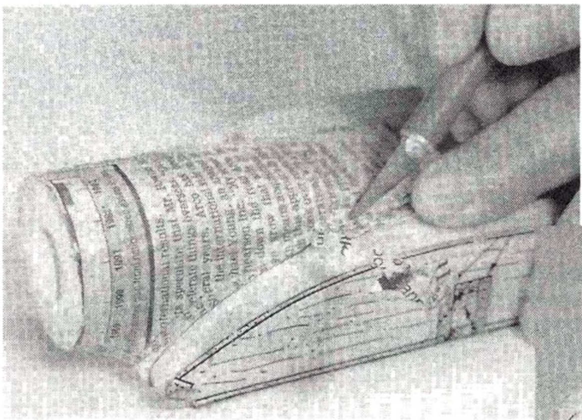
6 To start the cowl layup, I wrapped a single wetted strip around the straight portion of the cowl form and held it in place with glue at the overlap.

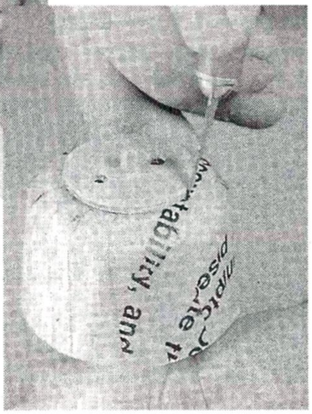


7 Apply more glue to the first layer in a dry "windmill-blade" pattern as shown. Lay down the "blades" one at a time; use glue to bond each to its neighbor. To hold the pattern in place, a cross-slit in the pattern's center slides over the 1/8-inch-diameter dowel.

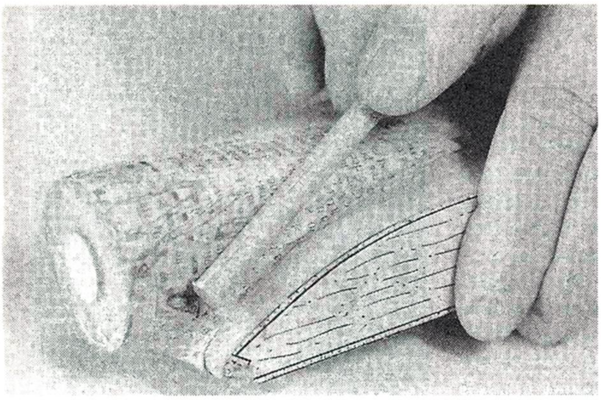


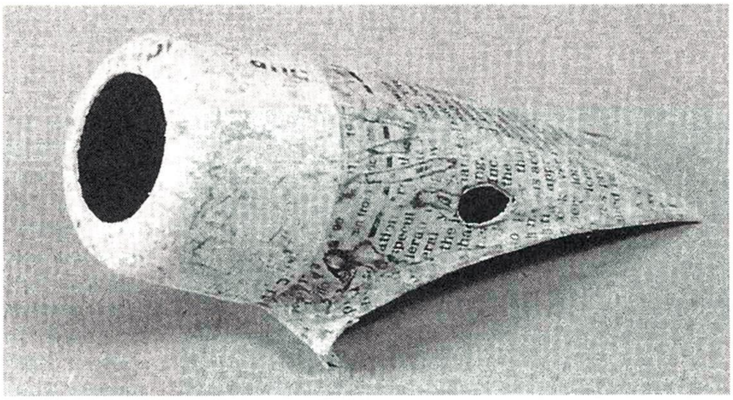
8 Next, apply more glue to this layer; then tightly apply a wraparound layer, with axial flaps cut at the front. Lay down the flaps around the front curve of the cowl, using a liberal amount of glue. Lay up the windmill and wraparound patterns alternately until you achieve the desired buildup. As with the nacelle, smooth each layer tightly, burnish wrinkles ,and apply a final coat of glue to the last layer.



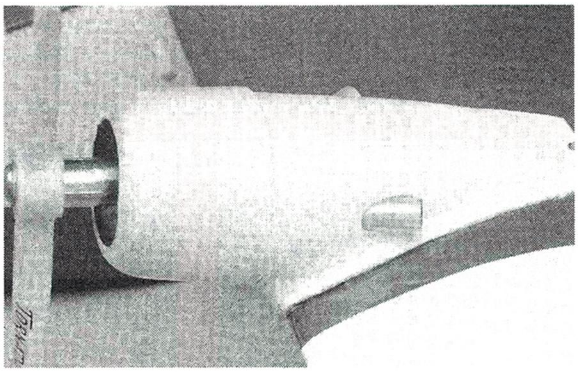


9 After the layups have dried, trim them. A no. 11 hobby knife works well for trimming edges and cutting openings.





10 After I trimmed them, I sanded the layups smooth with 200-grit garnet paper to remove bumps and wrinkles; next, I removed the layups from their forms. Working a knife blade around the edges helps to loosen the layups; with some gentle twisting and pushing, they will pop off. Two 1/8-inch-square spacer strips were glued inside the nacelle at 45 degrees from vertical to align it with the motor o.d. These spacer blocks, together with the faired wing, overlap at the bottom, hold the nacelle firmly to the wing; only a single screw at the back is needed to secure it.



11 After I had epoxied the cowl to the nacelle, I applied several coats of automotive filling primer; between coats, I dry-sanded with 600-grit paper, then I used acrylic enamel as the final coat. I then epoxied the aluminum-tube stacks that exhaust the cooling air into the side openings and waterproofed the interior with epoxy paint.

12 With the finished cowl and nacelles installed, it was time to fly! The light, strong cowl and nacelles add much to the model's appearance. Try this laminating method the next time you need to make a cowl or fairing. Your friends won't believe you made it out of the morning newspaper.

Bubba Spivey's smokin' Laser 200 on a knife-edge pass.

14th ANNUAL JOE NALL GIANT-SCALE FLY-IN

by GERRY YARRISH

NESTLED AMONG the rolling hills of Greenville, SC, is a place to fly R/C airplanes that almost defies description.

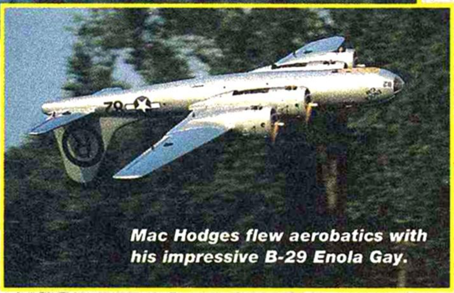
The runway is some 400 feet wide and more than 3,000 feet long and covered with carefully tended grass. Immediately behind the seven flight lines, a wooden gazebo and large tents offer welcome shade to the many pilots who are there to enjoy the event. The pit area (though it's too nice to be called that) is about 1,000 feet long. But that's just the flying field....

PHOTOS BY GERRY YA

Mike Stokes of JR Remote Control works on his Byron AT-6 Texan. That unusual engine is the Saito 3-cylinder 450 4-stroke—gobs of power!*

For non-fliers, picturesque wooded nature trails, two huge ponds—complete with geese and goslings—and a shady campsite are star attractions. There's room for tents, trailers, campers and motor homes. If Oshkosh can be considered the premier full-size-aviation fly-in, than the Joe Nall Giant-Scale Fly-In is the Oshkosh of R/C.

The Illusion—an attractive biplane from an Eagle Aviation kit. Built by Dennis Kirby; 70 in. span; about 20 lb.; Brison* 4.2.

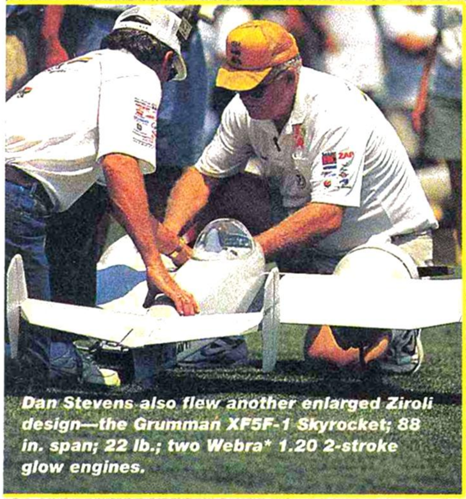


Mac Hodges flew aerobatics with his impressive B-29 Enola Gay.

Background: An aerial shot of Hartness Field, home of the Joe Nall Giant-Scale Fly-In.

Held every year on the weekend after Mother's Day (this was the 14th), the Joe Nall Fly-In is the result of the efforts and passion of Pat Hartness, Kirby McKinney and the Confederate Air Farce Club. Pat is the owner/founder of Hartness Intl. Pat owns the field, and the event honors his good friend and college classmate, Joe Nall.

Some people show up as early as the Sunday before the event. When I arrived on Thursday, I was struck by the size and splendor of Hartness Field—a beautiful country-park setting with shade trees, permanent buildings and paved roads. If you need to do repairs, instead of having to rely on whatever you can find in your field box, you can use Pat's huge workshop. And at night, instead of having to lug your model back to your camper or hotel room for charging, you can store it in the hangar where Pat usually keeps his VP-1 Volksplane, J-3 Cub and Stearman PT-17. Southern hospitality on a grand scale!



Dan Stevens also flew another enlarged Ziroli design—the Grumman XF5F-1 Skyrocket; 88 in. span; 22 lb.; two Webra* 1.20 2-stroke glow engines.

THE EVENT

More than just a giant-scale meet, the event, which is open only to AMA members and their guests, encompasses more than R/C flying. On Thursday night, at an open-air forum, full-size-aircraft pilots discussed safety, and then guest speaker Skip Shelton shared his many amusing aviation tales.

On Friday night, aviation artist John Gribbin discussed his B-17 painting "Return to Despham"; it depicts the 452nd Bomber Group and their mission over Pozan, Poland, on Easter Sunday, 1944. Bob Kilby shared his memories as a radio operator on one of the B-17s "Flatbush Floogies" that returned from that mission. Of the 33 bombers involved, 14 did not return.

A pit full of performance. Just a small section of the flightline and the models ready to fly.

Then there was the Saturday night barbecue held in Pat's backyard—1,000 people showed up! Yep! Pat and his wife, Mary Lou, not only fed the hungry modelers and their guests, but they also got them through the serving lines in about 25 minutes!

THE FLYING

But for diehard modelers, it's the flying that counts—and there were a lot of models on the flightline and in the air. The 460 registered pilots brought along an estimated 800 models! Many well-known modelers were on hand, and everyone enjoyed the flight demos and aerobatic routines.

Making his first appearance at the meet, Chip Hyde enjoyed flying Bubba Spivey's Lanier RC* Extra 300s while Bubba chased him with a giant Stinger. Frank Noll flew his Eagle Aviation* 38-percent-scale One Design in formation aerobatics with his friends Gerald Neel, Warren Thomas and Robart Clark: four, white-and-pink, giant-scale One Designs performing tight maneuvers—unforgettable!

Frank Noll's One Design in knife-edge flight.

Dennis Gergits and Warren Thomas flew a pair of Carden Aircraft* Extra 300s in an aerobatic "follow the leader," which was as much fun to watch as it must have been to fly. Frank Noll's son Jason also flew

John Bergsmith's beautiful $^1/_4$-scale Stearman PT-17; fully detailed; covered with polyester fabric and dope; 96 in. span; G-62 engine.

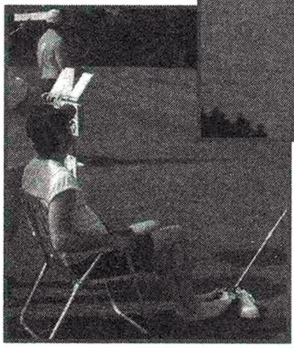
Warren's Extra, and we were all impressed to see this 14-year-old handle such a large aerobatic model with such skill.

To everyone's delight, Mac Hodges was back with his enormous B-29, Enola Gay—a 96-pound, 16-foot-span model powered by four Quadra 42 gas engines. Its size alone is impressive, and the sight of it flying loops, rolls and inverted is awe-inspiring. Mac also flew a magnificent ¼-scale Cessna 310 twin powered by two YS* 1.20s. And yes, Mac flew this one just as he pilots his B-29—very smooth!

C. R. Price flew a Laser 200—with his feet! He flies aerobatics that way, too. I even heard that he has been known to simultaneously fly two models with two transmitters in hand (hand and foot, that is!).

Piloted by John Kohler, Bill Steffes' AT-6 Texan roars by on a low pass; Ziroli* plans; 101 in. span; fiberglass fuselage; The Aeroplane Works* wing and tail kit; Sachs 32 engine.

C.R. Price has a unique flying style—bare foot! Moving the sticks with his toes, he flew a Laser 200 through some good aerobatics—all without lifting a finger!



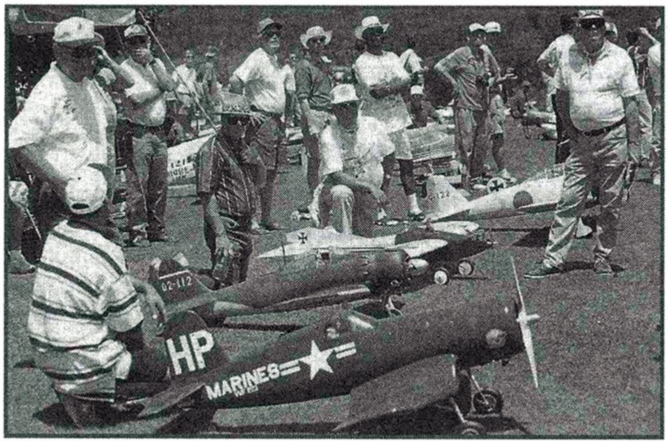
Above: C.R. Price's Laser 200 in knife-edge flight.

And, joining the fun, Pat Hartness flew his gigantic 44-percent-scale Extra 300S from the Geoff Combs kit. Powered by a big 4-cylinder 3W gas engine, the Extra was quite something. Pat has been a member of the AMA since 1956 and is no stranger to modeling. He is also obviously a very trusting soul because he let Frank Noll really wring out the Extra. He kept calm while it executed rolling loops, knife-edge flat spins and other TOC gyrations (but knowing Frank's piloting skills, Pat knew his plane was in good hands).

During the halftime break, Pat Hartness flew his beautiful, full-size Stearman PT-17, and Warren Thomas flew Pat's equally outstanding Piper J-3 Cub for several low-level photo passes. Good friend Jerry Smith hopped a ride in the PT-17, and I was given the chance to photograph the grounds from the Cub. Hartness Field—simply amazing when viewed from 400 feet; the models were lined up wingtip to wingtip, and they nearly covered the entire length of the runway.

Joe Grable holds the Bob Smith award for the most scale-like flight.

Warbirds were also a big part of the Joe Nall Fly-In.



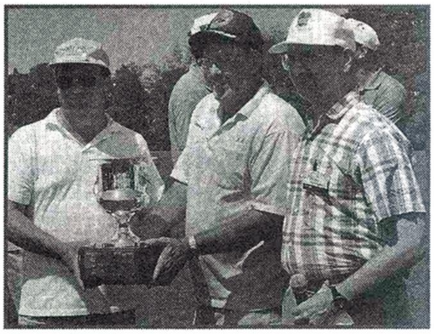
AWARDS AND THANKS

Even though this is an IMAA-sanctioned event, two awards are given annually. The recipients' names are engraved on the awards, and the following year, the award holders hand them over to the new stars.

- **Joe Nall Trophy**—awarded since 1990 to recognize a lifelong commitment to the R/C hobby and those who enjoy it. This year, Curtis Mees was honored.
- **Bob Smith Award**—for the most scale-like flight. Flying his Cessna 336 Skymaster, Joe Grable went home with this one.

Everyone involved with the Joe Nall Fly-In deserves thanks for their efforts. All the members of the Confederate Air Farce, Bob Sadler the announcer, CD Mike Gregory, Kirby and Carol McKinney and their daughter Laura and all the others involved did a wonderful job. My only regret was that I didn't attend sooner. Put this one on your "must go to" list. You won't believe your eyes.

Event announcer Bob Sadler kept everyone informed and well-directed. "Please keep all vertical flight maneuvers over the trees on your right-to-left flight pass, fellas!"



Joe Nall award winner Curtis Mees accepts his trophy.

New for 1996 will be October's Masters World Aerobatic Championship hosted by the Confederate Air Farce. Mark it on your calendar: Hartness Field, October 3 through 5, 1996. Thirty of the world's top large-scale R/C aerobatic fliers will duke it out for glory. For more information on this event and on the Joe Nall Giant-Scale Fly-In, contact Mike Gregory, P.O. Box 8218, Greenville, SC 29604.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

Kress Jets Computer Software

by KEN MYERS

Three programs for peak performance

MODEL AIRPLANE NEWS PRODUCT REVIEW

HAVE YOU ever invested your time and money in a model only to learn the hard way that it didn't work very well?

Here's a solution: spend a little time at your computer before you build. That way you can have an engineering and modeling expert—Bob Kress of Kress Jets*—right there with you in digital form, and you'll have the answers to many of your questions before you cut one piece of wood, purchase the motor, or order the wrong batteries.

With Kress Jets computer programs—*Electro Flight Design, Electric Prop Model Design* and *Ducted Fan Performance Prediction*—you'll have years of experience and test results at your fingertips. All three titles feature abundant written documentation so that you can concentrate on your results. One program requires Windows to run, but the others don't.

• *Electro Flight Design.* Use this Windows program (3.x and 95 versions) with your data to obtain a flight-characteristics profile of your proposed or revised model. The program has an easy-to-use Windows interface and an easy-to-understand graphic and numerical output. Among its useful features are online help and information on how to test motors for motor constants. The program will calculate model drag and horsepower requirements and evaluate electric motor performance; it also shows three examples each of optimum propeller selection and fixed propeller selection.

Chart 1 shows the characteristics of the old-timer Lanzo bomber so you can see all the useful information that this program can provide.

SPECIFICATIONS

Program: *Electro Flight Design*

Product: Windows-based flight-characteristics profile

Versions available: Windows 3.x and Windows 95

List price: $79.50

Features: easy-to-use Windows interface and easy-to-understand graphic and numerical output. Includes online help and information on how to test motors for constants.

Program: *Electric Prop Model Design*

Product: MS-DOS BASIC propeller analysis

Versions available: MS-DOS

List price: $79.50

Features: two BASIC programs that provide extensive prop analysis based on your input; will run on the oldest of PCs.

Program: *Ducted Fan Performance Prediction*

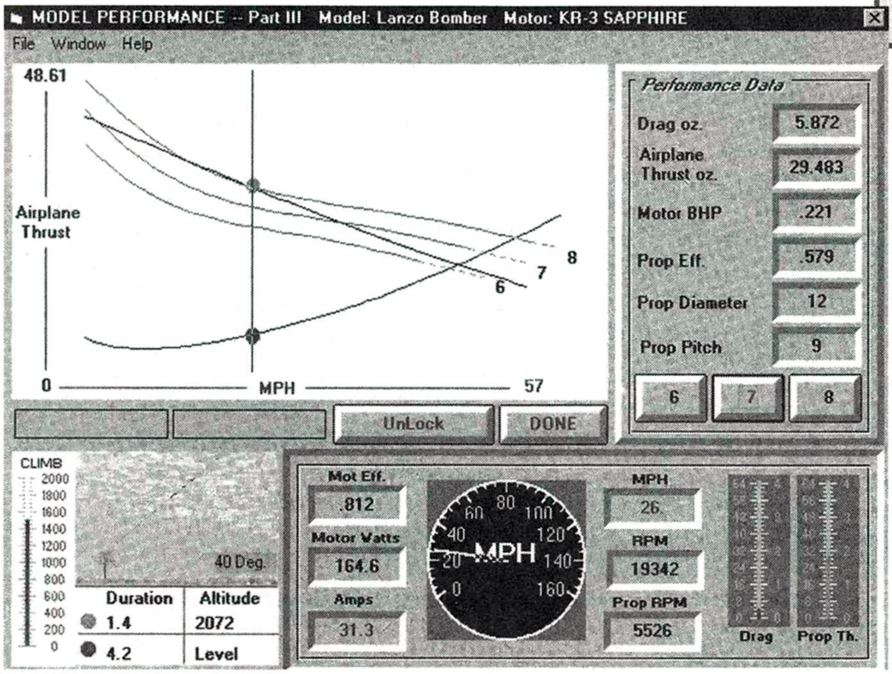
Product: MS-DOS BASIC ducted-fan performance analysis

Versions available: MS-DOS

List price: $69.50

Features: three BASIC programs (including one just for electric models) that provide charts, diagrams and graphs to predict ducted-fan performance

Comments: each of these Kress Jets programs will answer many of your questions before you even begin to design or reconfigure your model, so you'll be able to get it right the first time. Bob Kress's programs are the result of years of experience and testing; they are a worthwhile investment.



This screen capture shows the the information that you can obtain about the Lanzo bomber from Electro Flight Design. You'll learn the best rate of climb with a 12x4 prop with 3.5:1 gearing using 7 cells. Try different battery-cell counts (here I used 6, 7 and 8) and prop combinations to see what best suits your application.

• *Electric Prop Model Design.* This title includes two programs: *PROPRR1.BAS* and *PROPCAL1.BAS*. Because these are written in MS-DOS BASIC, you will easily see the "nuts and bolts" of the equations used; nothing is hidden. Although these programs don't have the nice, graphical interface of a Windows program, they yield usable results and will run on even the oldest of PCs!

PROPRR1.BAS supplies approximately the same output information as *Electro Flight Design*. According to Bob, "The prop analysis included in the mathematics [of the BASIC program] is actually more rigorous than *Electro Flight Design.*" It includes data for more than 150 motors.

If you input airspeed, rpm, prop diameter, pitch, blade width and number of blades, *PROPCAL1.BAS* will spit out "everything you always wanted to know

about your prop." It uses prop data from 1919 to the present.

The screen capture for the P-47 will show the useful data that you'll generate. As you add more data, more information and variable selections become available so that you can calculate many scenarios and find the best performance for your application.

• *Ducted-Fan Performance Prediction.* This title includes three MS-DOS BASIC programs: *FANJET4.BAS*, *FAN2ST4.BAS* and *EEEFAN1.BA*.

EEEFAN1.BAS is a modified version of *FANJET4.BAS* for electric fans. Although *FANJET4.BAS* could be used to predict electric-fan performance, Bob wanted to make it easier for electric fliers, so he wrote this special version.

FAN2ST4.BAS is a modified, two-stage fan version of *FANJET4.BAS*; both have charts, diagrams and graphs, as well as weather and altitude information in the written documentation. With such data, you should be able to figure out how to properly power your fan project.

RECOMMENDATIONS

If you have a PC that runs Windows and you like graphical interfaces, you might benefit most from using *Electro Flight Design;* I've used it almost exclusively for nearly two years. It's quick, accurate and easy to learn. The more I have learned about electric flight, the better my input into this program has become; the result has been a corresponding improvement in output.

If you don't have a Windows PC but you would still like accurate information about your proposed or revised project, *Electric Prop Model Design* Program is for you. Even if you have Windows and own *Electro Flight Design, Electric Prop Model Design* is a very good way to "get under the hood" and see what is going on, because it allows you to "list" the program and check out the mathematical models and concepts it used.

For those who enjoy fan projects, glow or electric, *Ducted Fan Performance Prediction* can help you get it right the first time.

HOW GOOD ARE THESE?

As with all programs, they are only as good as the expert whose information was used to create them. Thanks to Bob Kress, their information is valuable and useful. As with anything else, however, to be successful you must know something about your subject. Experience is a great teacher; to supplement it, gather information from books, magazines and newsletters that discuss electric flight. The more you know—combined with what Bob Kress knows—the better your projects will become.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

Chart 1.
Here's the information that *Electric Prop Model Design* will provide about a P-47 with a 46-inch wingspan and an area of 325 square inches.

Static performance with selected prop (diameter—11.20 inches; pitch—8 inches; gear ratio—2.5)

Prop rpm/1,000	5.79
Prop power, watts	118.3
Prop thrust, oz.	29.95
Air-mover prop efficiency	0.488
Prop-power coefficient	0.06089
Prop-thrust coefficient	0.11154
Motor rpm/1,000	14.48
Motor power, watts	124.6
Motor power, b.hp	0.167
Motor current, amps	20.12
Motor efficiency	0.739
System efficiency	0.645
Blade stall?	No

Chart 2.
Results of *Ducted Fan Performance Prediction* (glow version)

rpm	12,593.6
b.hp	1.064012
Thrust, lb.	5.823107
Vexit, mph	65.5021
Fan efficiency	0.4781462
NACA alpha	5.962265 deg.
Lift coefficient	1.268
Mass flow, lb./sec.	1.951306
Mean section tangential velocity	295.4942 ft./sec.
Mean section axial velocity	99.97452 ft./sec.
Pressure ratio	10.95688 lb./sq.ft.
Fan-pressure ratio	1.005178
Flow coefficient	0.3383299
Pressure coefficient	5.287405E-02
Mean radius	19.53774 deg.
Power coefficient	0.5327174
Thrust coefficient	58.74555
Rotor blade in upper surface stall.	

Center ON LIFT

by MIKE LACHOWSKI

LSF ACCOMPLISHMENT PROGRAM

THIS MONTH, I discuss how to measure your thermalling skills by using the League of Silent Flight Soaring Accomplishment Program. I also tell you how to get the most out of your computer radio's programming capabilities, and I have good news about the availability of the latest UIUC wind-tunnel test results.

LSF ACCOMPLISHMENT PROGRAM

The League of Silent Flight (LSF) has become the official soaring "special interest" group for the Academy of Model Aeronautics. LSF has always promoted soaring accomplishments and, in recent years, it has organized and run excellent contests. Now the LSF will be working with the AMA to promote soaring by holding events such as this year's LSF/AMA Soaring Nationals. For more information, contact LSF, Box 682, Spruce Pine, NC 28777; email: 72132.1251@compuserve.com.

Bob Champine launches at a past LSF Nats. Bob is the only person who has completed Levels 1 through 5 twice.

In recent issues, I've included a variety of tips on improving thermal skills. An excellent way to measure your ability is with the LSF Soaring Accomplishment Program. This program includes five levels of accomplishments. Each level consists of different duration flight tasks, and some levels have landing tasks and competition requirements.

• **Level 1** is for beginners and requires a thermal-duration flight of 5 minutes and a slope-duration flight of 15 minutes. For those who can't conveniently get to a slope, a second thermal flight can be substituted for the slope flight. Also required are five spot landings that are less than 3 meters (9.84 feet) from a designated landing spot.

• **Level 2** increases the thermal duration to 15 minutes and the slope duration to 1 hour. These tasks and the longer flight times will really test your soaring skills. This is also the last level that has a landing task—10 landings within 1.5 meters (4.92 feet) from a spot. You must also compete in a certain number of contests or win points in competition (club contests count!).

• **Level 3** starts to challenge your flying skills. Task-duration times increase to 30 minutes and 2 hours. A half-hour thermal flight usually requires finding multiple thermals. This level replaces the landing requirements with a Goal and Return flight of 1 kilometer (.62 mile)—a short distance that can be flown from a fixed point with someone at the far end of the course to confirm your distance before you return to the launch point. At this distance, you'll have to gain sufficient altitude to complete the flight.

• **Level 4** is where most pilots stop. Thermal flights of 1 hour and slope flights of 4 hours are much more difficult. Many pilots have logged 58-minute flights trying to achieve a 1-hour thermal flight! The Goal and Return also increases to 2 kilometers (1.24 miles). While this can be accomplished by flying 1 kilometer to the left and right of the pilot, try to fly from a moving vehicle if you intend to go on to Level 5.

• **Level 5**—the highest level—includes a 2-hour thermal flight, an 8-hour slope flight and a 10-kilometer (6.2 miles) Goal and Return flight. To qualify for this level, you must have already won three contests in which 20 or more pilots have competed. Plenty of pilots have made it through Level 4, including me, but only a hardy few take on Level 5. The 8-hour slope flight is the most challenging part of this level; it takes preparation and good weather conditions for 8 hours of flying. The 2-hour thermal flight also requires good weather conditions.

The LSF Soaring Accomplishment

Program provides everyone, regardless of his skill, a level on which to work. The goals provide you with a sense of accomplishment and an end to work toward while building and flying. If you belong to a club, you should get everyone to complete Levels 1 and 2. It's a great club project and an excellent way to help new pilots improve their flying skills.

SELIG'S AIRFOIL DATA—VOLUME 2
You can now order the "Summary of Low-Speed Airfoil Data, Volume 2"—the second installment of the wind-tunnel tests that Michael Selig and his graduate students have been conducting at the University of Illinois at Urbana-Champaign. Twenty-five airfoils were tested, many with a variety of flap and turbulator configurations. Continuous improvement of the wind tunnel and the data-reduction system have resulted in more accurate, reliable data. The team is still improving these systems. In the next series, increased accuracy and the addition of airfoil pitching-moment data will be discussed.

Volume 2 is based on the second series of wind-tunnel tests at UIUC. A third series of tests has now begun, and Michael Selig expects that some time before the end of 1996, Volume 3 will be published.

Volume 2 is 251 pages of narrative and data much like Selig's previous works: "Summary of Low-Speed Airfoil Data, Volume 1" (1995) and "Airfoils at Low Speeds" (SoarTech no. 8, 1989). Volume 2 is similar in content and organization to Volume 1, and it's similar to the material in "Airfoils at Low Speeds." The price in the U.S. is $25 (including postage).

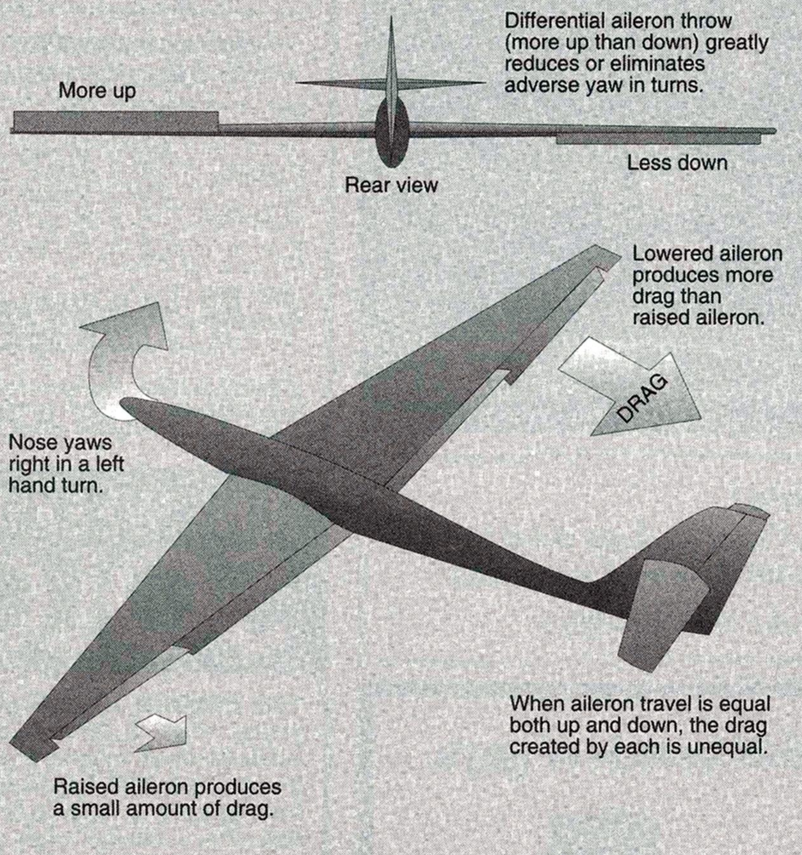
All of the actual tabulated data and airfoil coordinates (but none of the narrative or illustrations) in the book are available on disk in ASCII text files. A program for using these files is not included on the disk, but you can use the data in your own programs. The price for the disk data in the U.S. is $15 (including postage).

To order Volume 1 or 2 from outside the U.S., add $4 to the basic U.S. price for international surface mail. For airmail within the Western Hemisphere, add $6 to the basic U.S. price. For air- mail to Europe, add $13, and for other parts of the world, add $17. For disk orders from outside the U.S., add $1. A significant portion of the proceeds from all book and disk sales will be used to support Selig's ongoing test program at UIUC.

SoarTech 8 has a base price in the U.S. of $20, and the international surcharges are the same as for Volumes 1 and 2. Data disks are also available for Volume 1 and SoarTech 8. Please feel free to contact Soartech Publications by email: herkstok@aol.com, or write to SoarTech Publications, 1504 N. Horseshoe Cir., Virginia Beach, VA 23451.

To order, please send a check or money order in U.S. dollars that can be paid at a U.S. bank. Residents of Virginia, add 4½ percent sales tax.

Adverse yaw



DIFFERENTIAL

Typically, with a new model, I adjust the amount of aileron differential. Use differential to make the aileron up-travel greater than the down-travel. You need to do this because of the differences in drag on the two ailerons. The down aileron causes that wing section to operate at a higher lift coefficient and lifts that panel. Along with greater lift comes more drag. Unfortunately, the wing with the down aileron is typically on the outside of the turn. The extra drag makes the model want to yaw in the opposite direction of the turn. One way to counteract this difference is to decrease the down-travel while increasing the up-travel of the aileron on the other wing.

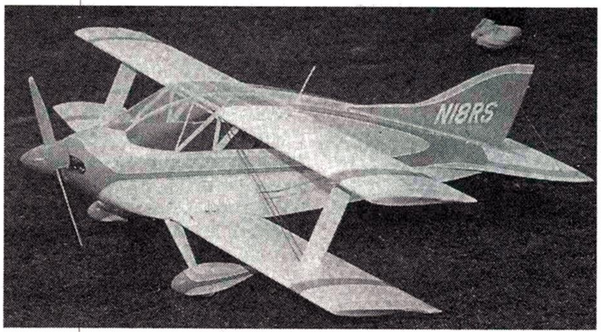
How much differential should you use? A good starting point is to make the aileron go up twice as much as the other aileron goes down. You will still find some yawing tendency, but you should be closer to an axial roll. It's best to test this without an active aileron-to-rudder mix. You can fly away from yourself and alternately apply left and right aileron. Adjust the differential to reduce the amount the fuselage wobbles. Avoid the temptation to use travel limits. I'll discuss this further in a future issue.

Scale TECHNIQUES

by BOB UNDERWOOD

FLYING WIRES AND WING ASSEMBLY

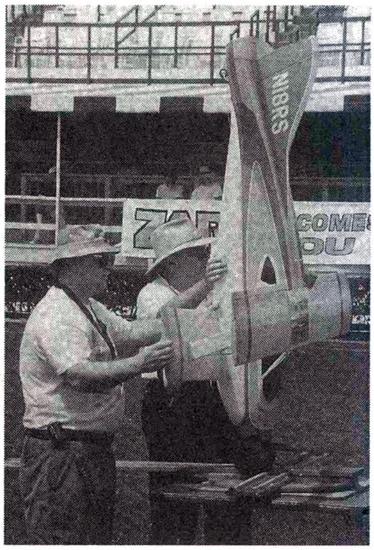
THE INSTANT I saw it, I knew that someday I'd have to build a model of it! It was in the little-known book, "WW I Warriors" by Reginald Finkelstein, the only source I know for material about the famous (infamous?) Widget 10. This early 1900s bomber designed by Wyndon Widget is the perfect modeling subject, especially for competition. Although the photos in Finkelstein's book are not of the best quality, there are plenty of them. This is especially extraordinary when you consider that only one of the "10s" ever made it to the flying stage. Coupled with a vast amount of text, the photos provide adequate documentation.



As you can see here, the Hiperbipe has negative-stagger wings and concealed flying-wire ends. Bob's method of removing the wings allows him to keep the rigging wires in place.

What makes the Widget so appealing? The fuselage actually consisted of three pods set in a vee formation. The central forward pod carried the pilot and copilot. The latter, in this case, performed a number of duties that included acting as navigator and providing the motive power to retract the 13-wheel undercarriage. This consisted of a main gear of six spoked wheels in each pod and a single nose wheel in the central pod. It is said that the copilot needed to be "of a hefty nature" to turn the geared crank that raised the main gear. The copilot also served as a communication engineer. This task was necessary because the noise of the 10 engines made it impossible to talk to the other four crew members (two bombardiers and two gunners) in the other pods. Communication was by flags.

The "10" featured an unusual boom configuration. The long, slender pieces connecting the bomber/gunner pods and the tail were curved slightly upward, like long bananas. Legend has it that this interesting design was not planned but was created by a construction mistake that resulted in the curve. The aircraft's completion was delayed one month while the builders worked to duplicate the graceful arc in the second boom.

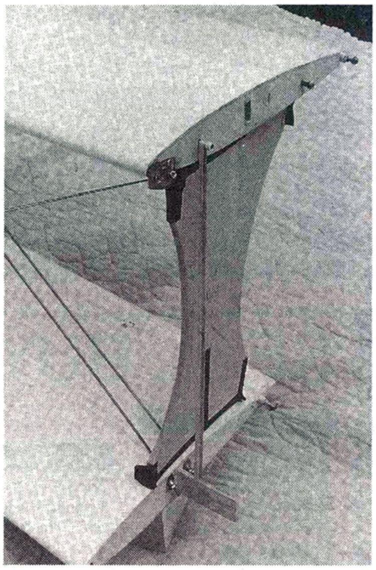


At the 1996 Top Gun Scale Invitational, author Bob Underwood and Cliff Tacie (left) hold Bob's Hiperbipe for static competition (Bob placed 10th in Expert). As with all biplanes with flying wires, special consideration is required to assemble and disassemble the model for transportation. (Photo by Stan Alexander.)

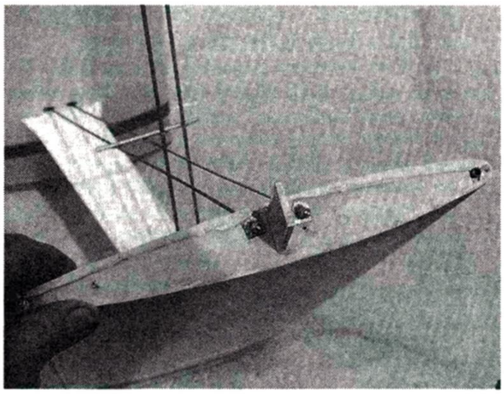
As a braced biplane, the "10" carried many feet of wire and six interplane struts. This does not include the sets of mounts for the engines, which were between the wings. Another distinctive feature was the set of four vertical fins and rudders.

Although putting an aircraft into combat without test flights was unorthodox, it was done with the "10." The first, and only, flight it made was indeed tragic. Before a dawn mission, it was discovered that the engine-starting procedure had not been carefully thought out. A crew member standing on a 2-meter stepladder had to hand-crank each engine. Because only one ladder was available and the engines proved balky to start, engine number one ran out of fuel before number 10 could be started. Refueling and restarting consumed most of the day and available fuel. As a result, the mission did not get under way until late evening.

Although the "10" delivered its 150-pound bomb load, it never returned to base. The wreckage was presumed lost in the English Channel and was never recovered. None of the six crew members was found, but it was rumored that several survived. It was believed that they disappeared because they feared being reassigned to the second "10" under construction at the time. But the War ended the following week, and the second



This is how the wing panels travel when not attached to the fuselage. The plywood brace supports the root end of the wing while the interplane strut remains in place to support the outer end of the wings. The flying wires remain in place.


The rigging wires can be adjusted at the wing's root. The fitting ends of the wires are buried either in the wing or the fuselage and are hidden from view.

"10" was never completed. Another rumor has it that parts of the boom were ultimately used as the framework for another project and can be viewed whenever the Oscar Meyer vehicle is in your area.

FLYING WIRES

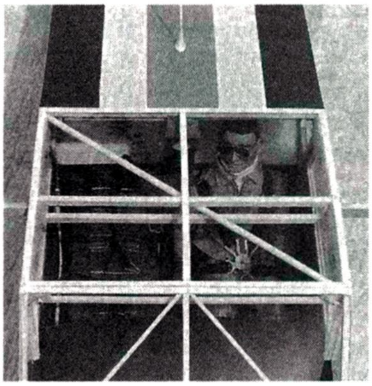
This month's technique was inspired by the preponderance of wires on the "10." Many of you may have considered building a multi-wing aircraft but shied away from it because of the need to rig it with the necessary flying and landing wires. In addition to the difficulty of building biplanes, modelers may be daunted by the complexity of rigging them and assembling and disassembling them at the field for transportation.

First, your research will tell you whether the model you wish to build features plain old round wire or that more modern version of "wire" or rod flattened by being rolled into a thin, symmetrical airfoil section. My Hiperbipe, for instance, uses "wires" that started as steel rods. The exposed sections are rolled into shape, and the threaded ends are left round. This shape has been difficult for modelers to reproduce.

If the type of wire just described is what you need, there is a source. Contact Jerry Nelson at Nelson Aircraft Co., 21550 Northwest Nicholas Ct., Unit D, Hillsboro, OR 97124; (503) 629-5277. Jerry's company sells smaller wires produced using exactly the same procedure as that used for full-scale. They have both right- and left-handed threads and come equipped with scale-size clevises, locking nuts and cotter pins. They are the "real" thing in every sense of the word! I will caution you about two things, however. Because the wires are custom-made, the company needs up to six weeks to fill your order. Also, keep in mind the precise nature and amount of work involved, and don't expect these wires to sell for $1.98 each! By the way, if you haven't seen Jerry's booth at various trade shows, you've missed a wonderful source of hard-to-find hardware and materials. I am currently using some of his water-based System Three paints, which are fantastic to work with. More on them later! At the Toledo hobby show, he premiered sets of custom-made bell-cranks and pushrods that had virtually zero slop!

What if you want to make your own flying wires? My technique, though time-consuming, works well. Each wire consists of a piece of music wire, aluminum tube and end fittings that are silver-soldered onto the music wire. The aluminum tube is window dressing that is shaped around the wire. The process is as follows:

1. Cut aluminum tube to the length required to match the flattened length of the finished wire.
2. Coat music wire with slow-setting epoxy and insert it into the tube. Gently work it back and forth, and turn it to distribute the epoxy evenly.
3. Using a vise with soft pine blocks covering the steel jaws, gently begin to squeeze the tube a little at a time between the wood blocks. Work from one end of the tube to the other. The key is to keep the "squeeze" gentle and to overlap the "squeezed" areas. Gradually, you will give the tube an oval cross-section. Experiment with the wire and tube diameter to arrive at a proper thickness and width.

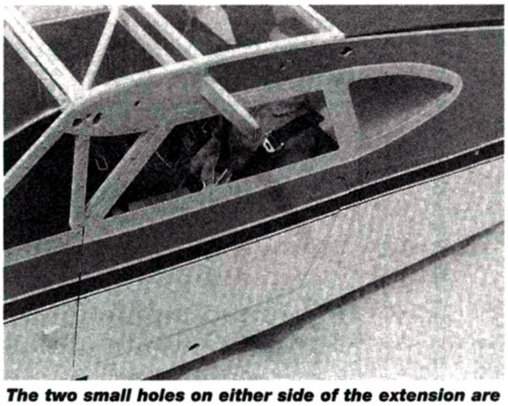

The fuselage crosspiece and the extensions are cut out of a single piece of aircraft-grade plywood to simulate the welded-steel framework of the full-size aircraft. The upper wing panels slide onto the two extensions.

4. After the epoxy has set, begin to shape the tube edge with a fine file. It can be formed into a fairly sharp edge.
5. When you have the proper shape, dress the tube to achieve a smooth, polished finish. Do this with 400-grit wet-or-dry sandpaper followed by 600-grit and, finally, automotive polishing compound.
6. The threaded end fittings can be made out of threaded couplers silver-soldered to the music wire. By squeezing the unthreaded portion of the couplers and then filing it, you can match the squeezed aluminum tube. If the fittings are buried in the wing, as on the Hiperbipe, simply make a loop in the wire, and secure it with a wood screw or what-have-you to an internal block.

WING ASSEMBLY

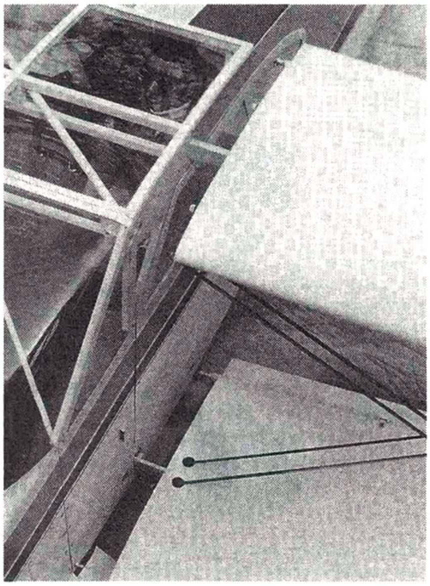
The first Hiperbipes I made were smaller and were in one piece. My current model,* with an almost 73-inch span, has to be taken apart for transportation. Also, because the flying wires and attachment points are buried in the wing or fuselage, I needed a way to keep each pair of wing panels together without separating them on disassembly. The photos reveal the method used.

The scale-size cross-member, or spar, running across the cockpit roof is 1/4-inch aircraft-grade plywood. It is shaped out of a single piece to simulate the welded steel of the full-size aircraft and has a tongue that extends into the wing itself. The box spar in the wing accepts the tongue with a tight fit. The top wing root is held on the fuselage side by two 6-32 bolts accessed through the cabin doors.


The two small holes on either side of the extension are for 6-32 machine screws that hold the upper wing against the fuselage.

The bottom wing uses the type of aluminum wing joiners sold by Sig Mfg.* and Byron Originals*. Of course, the aluminum joiner is held in place by a 6-32 screw that is also accessed through the cabin.

The flying wires never leave the wings, nor do the interplane struts have to be disassembled. A brace was fashioned to hold the wing-root ends when the model is disassembled. The flying wires are adjusted at the wing-root ends. Actually,



When the wings slide home, they automatically align and engage the aileron drive units, which can be seen near the trailing edge of each wing panel.

since they were set, they haven't had to be adjusted in two seasons. I have been asked whether the wires on the Hiperbipe are functional. In other words, would the wings stay on in a loop if the wires weren't there? I haven't a clue! I hope that I never find out. Incidentally, the wires on this model are from Jerry Nelson.

As you can see, the Hiperbipe uses four strip ailerons. Creating a plug-in system for driving them from the two servos in the fuselage was fun. This was true because while the upper wing is straight and has no dihedral, the lower wing is slightly swept rearward and *has* dihedral! Therefore, normal coupling fittings couldn't be used—at least for the bottom wing. But that's a story for another time.

A closing thought or two: I'm proud to say that the Hiperbipe managed a 10th-place finish at the 1996 Top Gun event. Although the plane has always done its thing well, it wasn't until this year that the pilot started doing *his* well!

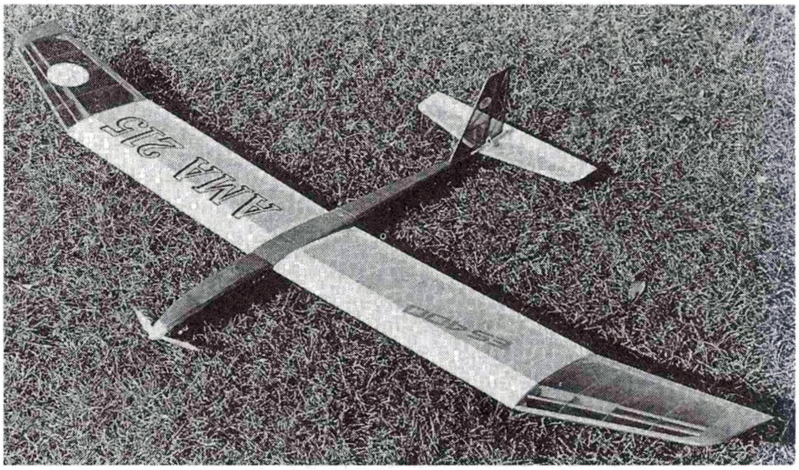
Years ago, I wrote a scale column for another magazine. In that series, I often referred to a "Widget 10" when I wrote of a generic subject aircraft. Even though it was described in what I considered outlandish terms, I received letters asking where people could get more information about it. If you've bothered to read this far, please know that there ain't no such bird! It's just that I couldn't resist having it rise again, like the Phoenix!

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

ELECTRICS

by TOM HUNT

CHOOSING THE RIGHT POWER PACKAGE



Designed by the author and built by Bob Aberle, the ES-400 is a Speed 400 electric sailplane for a new, proposed AMA 1/2A electric-sailplane event. The model weighs 19½ ounces, uses a 7-cell, 500mAh pack and has a 64-inch wingspan and 400 square inches of wing area.

IN MY APRIL '96 column, I offered suggestions on how to make structural changes to convert a glow model to an electric that flies well. But you'll also need help in choosing the right power systems—motors, gear-reduction box and batteries—for these converted models. This month, I'll discuss some computer programs and furnish charts that will streamline the decision-making process for you.

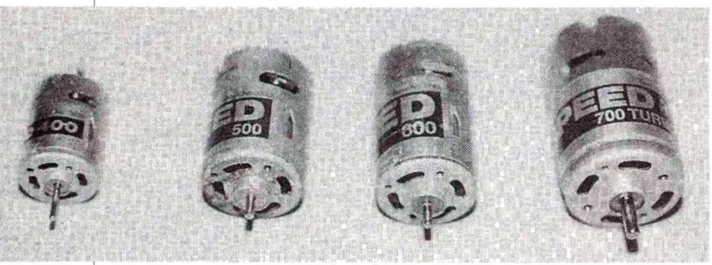
COMPUTER AID

Many people in our hobby detest having to do math to get their models to fly. To choose power systems, they rely on the advice of experienced modelers. This is one way to beat the rap! Another way is to let a computer do it for you. Two good computer programs that predict the flight performance of electric model airplanes are Kress's* *Electro Flight Design* and *AERO*COMP*. *[Editor's note: see the product review of the* Electro Flight Design *program elsewhere in this issue; for more information on* AERO*COMP, *see the November '92 and March '95 issues.]* Both are easy to use and give acceptable "first cut" results for choosing power systems, and for input, they need only a few parameters (wing area and span, model weight, etc.). This data can usually be found on your model's box label; call the manufacturer if you need more.

If you want to do basic calculations and consult charts, I can get you into the air quickly. My charts have been developed during years of experimentation and from data gathered from good-flying electric models all over the world. I'll consider only single-motor electric models; multimotor models and ducted fans will be the subjects of future articles.

HOW MUCH POWER?

How much power is required to get a model into the air depends on total weight, wing loading and the type of flying you want to do. Lightly loaded high-wing trainers need far fewer cells on board than do scale fighters of similar physical size. Powered gliders need even fewer.



The inexpensive Graupner Speed motor line ranges from around $11 for the Speed 400 (50 to 90 watts) on the left to around $48 for the Speed 700 (200 to 350 watts) on the far right. The Speed 500 (left center) and Speed 600 (right center) both range from 100 to 200 watts. The number designation divided by 10 reflects the approximate length of the motor case in millimeters.

A typical "plain Jane" .40ci glow engine produces about 1hp at max throttle, but a model typically requires less than half that to keep it flying comfortably. Many .40-size trainers are overpowered these days, but this has been the trend in glow-fuel modeling in the last decade. Many glow modelers think that if their model doesn't stand on its tail, it's not a good trainer—go figure! But, I digress.

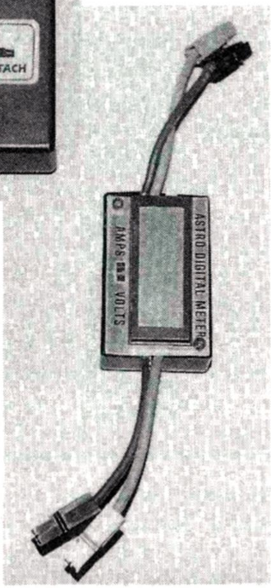
• **Wing loading.** Once you have selected the model type and wing area, refer to Chart 1 to find out the acceptable wing loading (ounces per square foot) and power loading (watts per pound). You'll notice that some model types have large wing-loading ranges; scale models, for instance, can range from 15 to 30 ounces per square foot, depending on the scale subject chosen and how many details you include. The range for powered gliders can be wide because of their large "load-carrying" capacity for duration flying. Notice that power loading varies quite a bit, too. Again, this value will determine how aggressively you'll be able to fly the model.

Let's say you'd like to convert a .40-size trainer to electric power. Electric power is measured in watts (746 watts = 1 hp). How many cells are required to get this trainer airborne? The chart says that a trainer with 600 square inches of wing area should have between 17 and 25 ounces per square foot of wing loading. The chart also expects this model to require between 50 and 70 watts per pound to get aloft. Let's take both ends of the range to compute the number of cells required:

$600 \div 144 \times 17 = 70.83$ ounces.

In other words, the wing area in

square inches (600) divided by 144 square inches in a square foot, then multiplied by wing loading (17) equals 70.83 ounces, or 4 pounds, 7 ounces. Because 50 watts per pound is the lowest acceptable power loading, this will give us the lowest number of cells required; using fewer cells will help to keep the weight down. At 50 watts per pound and a weight of 4 pounds, 7 ounces (4.43 pounds), the number of watts required will be 50 x 4.43 = 221.5 watts.



Two of the electric modeler's most important tools: the tachometer (this one from TNC Electronics*) and the ammeter (this one from AstroFlight) for measuring prop rpm and motor current—important indicators of electric model performance.

• **Number of cells.** To convert watts to number of cells, you must decide how much current you'd like to draw from your battery. This, of course, depends on your motor. Typically, inexpensive "can" ferrite motors (those with sealed endbells that don't allow you to change brushes or adjust timing) can handle up to 25 amps (10 amps for Speed 400-type motors). More expensive cobalt or neodymium motors can handle nearly twice that for short periods, but I like to use 30 amps. Watts equal amps x voltage; because a conservative voltage rating for a 1.2V Ni-Cd cell under a 25A load is 1 volt, dividing 221.5 watts by 25 yields 8.86 volts, or 9 cells (rounded). Nine cells to fly a 600-square-inch-area trainer, Tom? From practical experience, this data tells us that this trainer had better be a stick-built old-timer or a similar model; if this is true, the model just might fly on 7 cells! The chart does have quite a bit of overlap.

At the other end of the chart's range: 25 ounces per square foot wing loading and 70 watts per pound. At these values, we have:

600 ÷ 144 x 25 = 104.2 ounces,
or 6.51 pounds.
Then, 70 x 6.51 = 455.73 watts, and
455.73 ÷ 25 amps = 18.66 volts; that indicates a need for 18 to 19 cells.

This weight and power seem more reasonable for sprightly performance in a .40-size trainer. That's quite a range: 9 to 18 cells for a 600 square-inch-trainer!

Let's imagine you already have a trainer built and covered with the radio installed, and it's time to choose a power system. The model weighs 3 pounds at this point. Because the weight of the motor system (motor and battery) will always be at least equal to the weight of the airframe, the total model weight will be approximately 6 pounds. Multiplying the total weight by 70 watts per pound yields 420 watts. Assuming that you'll draw 25 amps from the motor, you'll need 16.8 volts, or 16 to 17 cells. A Graupner Speed 700 motor/belt drive with 16, 1700mAh cells just happens to weigh 3 pounds.

This calculation chart may not cover all model types and flying styles, but it will give you a ballpark estimate of the power required for most model flying.

GEAR REDUCERS

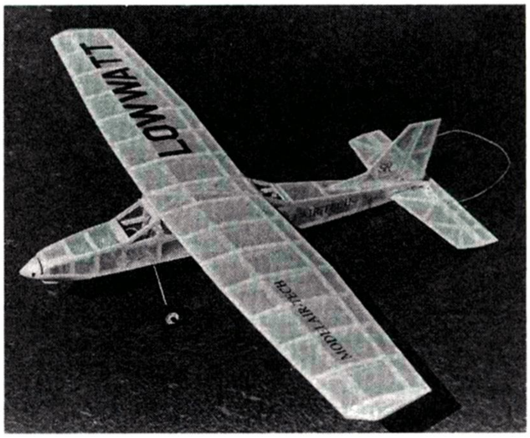
There's a simple rule of thumb for deciding whether to use some sort of gear-reduction unit (gearbox) or to use direct drive (prop on motor shaft). Do you want to go like the hammers of hell for short flights or fly longer with good climb rates and moderate speeds? If you want the former, use direct drive; if the latter is more your style, use a gearbox. Direct drive is appropriate for pylon racers and high-speed, multitask sailplanes as well as some smaller, hand-launched 5- to 7-cell models that need to go fast to fly comfortably. All other models—scale, sport, fun-fly and duration gliders—benefit tremendously from having some sort of gearbox between the motor and prop.

Speed reducers (actually rpm reducers) are of two main types: gearboxes and belt drives. There are advantages and disadvantages to each.

Gearboxes. These come in three main types:

• **external** (available from Astro-Flight*, Graupner*, Leisure Electronics*, Master Airscrew* and Model Electronics Corp.*);
• **internal spur** (Hobby Lobby* titanium);
• **planetary** (Graupner, Pica/Robbe*).

External and internal-spur gear drives have some "offset" between the motor shaft and the propeller shaft; planetary gear drives are "in line" (no offset). All have the advantage of fitting into small, tight cowls. Some manufacturers offer several different ratios, but they aren't easily changed (except for the Model Electronics SuperBox). Most gearboxes have press-on "pinions" (motor-shaft gears), and those with setscrew attachment at the motor are limited in input watts. These press-on pinions don't make changing ratios easy. Some of these units are



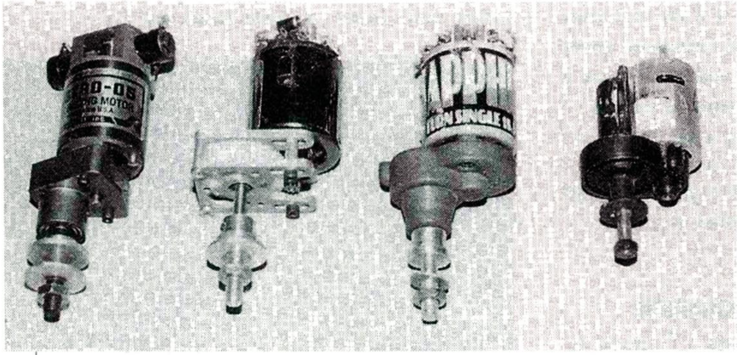
The author's Lowwatt—a Speed 400 schoolyard model with rudder/elevator and motor control. As configured, it has a 6V motor and a 6x3 folding prop driven by a 6-cell, 500mAh pack. It weighs 15$^1/_2$ ounces and has a 200-square-inch-area wing. The model is made almost exclusively of $^1/_8$x$^1/_4$-inch strip wood. Flights last for more than 4 minutes.

light; however, light weight is synonymous with low input power. The planetary units are heavier (some weigh as much as a motor) but can usually absorb a lot of power. A well-designed gear train that's properly attached to the motor might have as little as 3 percent loss in power-transmission efficiency; however, 5 percent is a conservative number.

Belt drives. Some of these (Graupner, Kruse* and Modelair-Tech*) offer an easy change of ratios—even at the field—with the change of just the pinion pulley. Belt drives typically weigh a little more than similar power-absorbing gearboxes; however, in larger 5- to 20-pound models, a few ounces won't make much difference in the total weight of the vehicle—a small price to pay for ratio flexibility when you're experimenting with flight performance. Belt drives usually have a higher offset between the motor shaft and the propeller shaft, but again, this usually isn't a problem in larger models as there is generally more room under the cowl. Properly setup belt drives have efficiency losses of between 5 and 6 percent.

Although some people have suggested that "tension" in the belt causes undue wear in the motor and motor-shaft bearings, there is *no* pre-tension in a timing-belt-type belt drive. (All belt drives that I am aware of do not cause wear of the motor or motor-shaft bearing.) The only tension in the belt is "running tension," which isn't high enough in most larger ball-bearing electric motors to cause excessive wear; in the less expensive, journal-bearing "sealed brush" motors, the brushes and commutators wear out long before the front journal bearing does. While maneuvering, propeller disk loading (both radial and axial) on a direct-drive model imparts far greater load to the front bearing than does the "running tension" of a belt drive. Another fallacy: a gear-driven system doesn't put any side load on the motor shaft. It does! What it *does* remove is the axial load (because of thrust) and radial load (gyroscopic precession) produced by the propeller. These forces are absorbed by the prop-shaft bearings.

In all drives—whether gear or belt driven—the main concern should be to keep foreign matter out of the mating faces of the gears or belt/pulley grooves and out of the shaft bearings. Most good gear/belt drive systems use sealed ball bearings on the prop shaft, so the latter is not a problem.



Smaller model motor/gearbox combos (left to right): AstroFlight FAI-05-5t competition motor and 2.38:1 gearbox for 7 to 10 cells; Model Electronics Turbo 10+ and SuperBox at 6:1 and 7 to 10 cells; Trinity* Sapphire and Master Airscrew 2.5:1 gearbox for 7 to 8 cells; Graupner Speed 400 (6.0V) and MFA Mini-Olympus gearbox at 2.3:1 for 5 to 7 cells.

RATIOS/PROPS

So, how do you pick the proper ratio/prop combination for a model, regardless of the type of transmission (gear or belt)? (Sorry, but I'm *not* going to give you mass quantities of formulae depicting motor electrical constants and propeller coefficients to make this task more scientific.) You'll need two very important pieces of equipment—an ammeter and a tachometer. It's virtually impossible to understand the health and power of an electric motor system without these. Once you're equipped, refer to Chart 2.

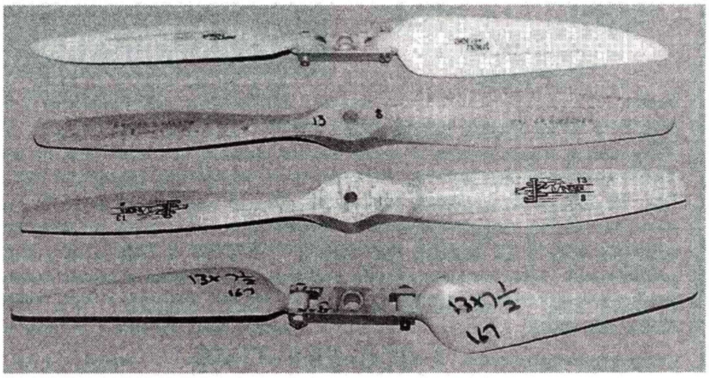
You can almost relate propeller diameter to wingspan: 6- to 8-inch props look silly on 6-foot-span motored gliders, just as 14-inch props look inappropriate on 1/4-scale J-3 Cubs. Gear drives on inexpensive .05 can motors allow the powered sailplane modeler to use much larger and more efficient props turning at slower speeds (and usually drawing less current). High ratios such as 3 or 3.5:1 usually provide the lowest current draw and acceptable rates of climbs in these models. Lower ratios, such as 2 or 2.5:1, draw more current (using the same props) and provide near-vertical climb rates in competition sailplanes. In sport models, direct drive seems inappropriate, but because you still want to go reasonably fast, choose a unit with a lower ratio—2:1 or less. If endurance is what you're after,

Chart 1: Calculating Power Requirements

Model type	Wing area (sq. in.)	Wing loading (oz./sq. ft.)	Watts/pound
Sport	150 to 200	10 to 14	40 to 70
Sport scale	150 to 250	17 to 25	50 to 80
Powered glider	300 to 400	7 to 10	40 to 60
Racer	150 to 200	12 to 14	70 to 80
Sport	250 to 350	15 to 20	50 to 70
Sport scale	250 to 400	17 to 25	60 to 80
Powered sport glider	500 to 650	8 to 12	40 to 60
Powered competition glider	500 to 650	8 to 12	100 to 150
Racer	250 to 300	15 to 20	80 to 100
Sport	400 to 600	15 to 20	50 to 80
Sport scale	450 to 700	20 to 30	60 to 90
Powered glider	700 to 1,000	10 to 15	40 to 60
Trainer	500 to 600	17 to 25	50 to 70
Sport pattern	700 to 800	25 to 30	100 to 150
Sport	700 to 1,000	15 to 25	50 to 80
Sport scale	800 to 1,000	20 to 30	70 to 100
Trainer	800 to 1,400	15 to 25	50 to 70

choose ratios greater than 2.5:1. In scale models, where nearly scale prop diameters (and scale number of blades) are desired, higher ratios are more appropriate.

After you've chosen your motor and speed reducer, picking the proper propeller is easy. Chart 2 specifies the type of model (sport, sailplane, or scale), the wing area range and a propeller range. (I'm sorry the propeller ranges are so wide, but that's where the next part comes in handy.) The propeller pitch is assumed to be 0.4 to 0.7 of the diameter in all cases. (I'm assuming that most modelers have access to a variety of propellers.) In the model or on a test stand, put any prop that seems appropriate (according to the chart) on the shaft. Run the motor at full throttle, and measure the current and rpm. If the current is excessive, shut the motor down right away, change to a smaller-diameter prop of the same pitch, and run the test again. You're looking for a maximum current of 25 amps regardless of the number of cells running the motor. Once the proper current-drawing prop has been obtained, fly the model. If the propeller that draws the recommended 25 amps is too small, you'll need a higher ratio for this motor (recommended) or you'll need a motor with more "winds." Although you may also use fewer cells in the battery, this is not recommended. If the motor doesn't draw enough current—even with a very large prop—you can change to a lower ratio; add cells to increase voltage, amperage and power; or change to a motor with fewer winds.



All these props have approximately the same pitch and diameter; however, because of their airfoils and blade shapes, they absorb energy at different levels. Top to bottom: Aeronaut* 13x7.5 folding; Master Airscrew 13x8 electric wood; Zinger* 13x8 wood; Sonic Tronics* 13x7.5 folding.

Another consideration: rpm readings are important; keep can motors under 20,000rpm and more expensive cobalt and neodymium motors under 25,000rpm. Expect excessive brush/commutator wear if you run any of these motors at these rpm for prolonged times, regardless of the current/voltage level. Remember to multiply the propeller rpm by the gear ratio to get motor rpm.

Motor characteristics (electric and torque constants) play a large part in deciding whether you use a high or low ratio gear/belt drive. Typically, if motors (of the same physical size) have different nominal voltage ratings, the motors with the lowest voltage rating need higher ratios, and higher-voltage motors need lower ratios to keep the props reasonable in size.

Whenever flight performance seems to be degrading, go back to the ammeter and tachometer. If you recorded these current and rpm values when the system was new, you have sound technical basis for suspecting things are amiss. If the current is higher and rpm is lower, something is wrong with the motor. If the current and rpm are lower, your battery may be at fault.

One more thing: even if a motor's carton says it's 9.6 volts, it doesn't mean it has to be run on 8 cells. In fact, in many cases, this is the lowest number of cells to run this motor on. If you have the proper speed reducer and prop and you observe the rule of "no more than 25 amps or 20,000 to 25,000rpm," this 9.6V motor can be run on twice that voltage to nearly double the power output! Whenever the current measured on an electric motor system is too low and you can't go to a larger prop (because of ground clearance), consider adding a cell or two. The tremendous increase in power will easily make up for the small increase in weight.

I know this article has been a little broad; however, these guidelines should allow you to experiment without spending too much money to enjoy electric-powered flight. A wise man once said, "One test is worth a thousand expert opinions." Experiment, and you'll only be the wiser for it.

If you have questions about this or any other electric modeling subject, email me at thunt95147@AOL.com.

Chart 2: Choosing Gear Reducers

Model type	Wing area (sq. in.)	Reduction ratio	Prop diameter (in.)
Sport	150 to 200	1 to 2.3:1	6 to 10
Sport scale	150 to 250	1 to 2.3:1	6 to 10
Powered glider	300 to 400	2.0 to 3.5:1	6 to 10
Racer	150 to 200	1	5 to 6
Sport	250 to 350	1 to 6:1	7 to 13
Sport scale	250 to 400	2.5 to 3.5:1	11 to 13
Powered sport glider	500 to 650	2.0 to 3.6:1	11 to 14
Powered competition glider	500 to 650	2.0 to 3.8:1	10 to 14
Racers	250 to 300	1	7 to 8
Sport	400 to 600	2.0 to 3.6:1	12 to 14
Sport scale	450 to 700	2.0 to 3.6:1	13 to 16
Powered glider	700 to 1,000	2.0 to 3.6:1	14 to 16
Trainer	500 to 600	2.0 to 2.5:1	12 to 13
Sport pattern	700 to 800	1 to 2.0:1	13 to 15
Sport	700 to 1,000	2.0 to 3.6:1	13 to 15
Sport scale	800 to 1,000	2.0 to 3.6:1	15 to 18
Trainer	800 to 1,400	2.5 to 3.6:1	14 to 18

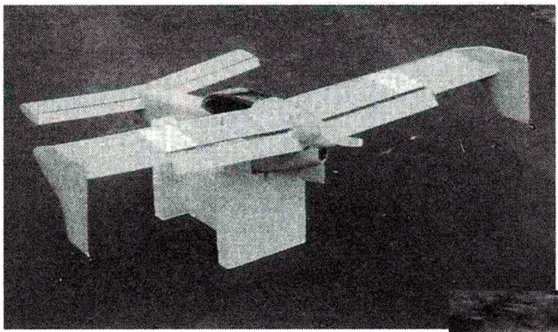
**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

MODEL AIRPLANE NEWS

HOW TO DESIGN for Aerobatics

by ANDY LENNON

IN THE DESIGN of an aerobatic model airplane, the first consideration must be for the heavy loads—both aerodynamic and structural—imposed by centrifugal force in high-speed, sharp, turning maneuvers. These loads are in addition to the model's own weight.



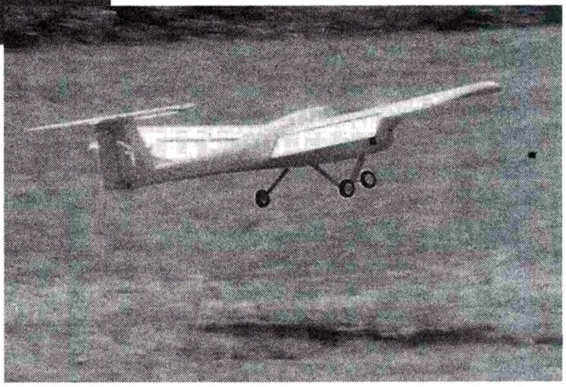
Model 4. The Swan canard.

A pattern ship flying at 100mph in a 120-foot-diameter (60-foot radius) turn will sustain loads of more than 12 times its gross weight. If the combination of wing area and the airfoil's lift coefficient (C_L) max is incapable of supporting this load, a high-speed stall will result. A panicked pull-up from a steep dive, at low altitude, that results in such a stall could be very damaging. Similarly, the model's structure must not fail under such heavy loads. (See "Stressed Skin Design," September and October '92 issues.)

It's true that at the higher angles of attack needed to support these loads, the model's drag will increase enormously; this slows the model and reduces the load. The highest load, therefore, occurs at the start of the maneuver—before drag slows the model appreciably. The problem lies in selecting the wing area and airfoil section that will support these heavy loads. To better understand this, five model aircraft with wing areas of from 400 to 800 square inches were analyzed.

The basis for this analysis is model 3, which reflects the specifications of the author's Swift. This model has a wing area of 600 square inches and grosses 92 ounces with a full tank (a glow-powered airplane with an empty tank cannot fly!).

All five have the same 0.46ci engine, R/C equipment and landing gear. Analysis of the Swift's weight discloses that the power and control units, plus landing gear accounted for 48.5 ounces. It was estimated that for each 100 square inches of wing area added to or subtracted from the 600 square inches, there would be a weight change of 5 ounces; a 700-square-inch-area model would gross 97 ounces, and a 500-square-inch version would weigh 87 ounces.



Model 1. The Swift.

The Swift's power loading of 200 ounces per cubic inch of engine displacement permitted sustained vertical climbs and vertical 8's with little discernible speed change.

All five wings used for this comparison *have aspect ratio 6* and taper ratios of 0.6, i.e., tip chord = 0.6 x root chord, and were unswept (see chart).

Wing area analysis

Model no.	Wing area (sq. in.)	Gross weight (oz.)	Wing load at 12.12 G's (in oz.) at 100mph	Wing drag at 12.12 G's (in oz.) at 100mph	Wing drag in level flight at 100mph (in oz.)	Wing loading (oz./sq. ft.)	Power loading (oz./cid)	Lift coefficient at 12.12 G's at 100mph	Landing speed (stall speed mph + 20%)	
1	400	82	994	77	6.6	29.5	178	0.874	35	
2	500	87	1,054	69	8	25	189	0.742	33	
3	600	92	1,115	67	9.7	22	200	0.654	29	
4	700	97	1,175	67	11.2	20	210	0.590	27	
5	800	102	1,236	67	16	18.4	222	0.544	26	

AIRFOIL SELECTION

Symmetrical sections perform equally well inverted and upright, have zero pitching moments and are ideal for aerobatic models. The airfoil used in this study was NACA 64_1-012—an early laminar-flow airfoil. NACA Technical Note 1945 provides data on this airfoil and NACA 0012 at Reynolds numbers (Rn) down to 700,000 (0.7×10^6). A 10-inch-chord wing flying at 100mph at sea level

is operating at an Rn of 780,000.

The disadvantage of symmetrical airfoils is their low maximum lift capability compared to cambered airfoils. This has two effects:

■ At high-G loads, additional wing area is needed.

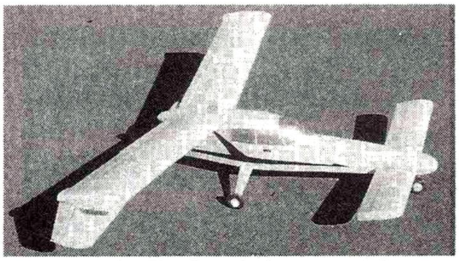
■ Landing speeds will be higher, unless slotted flaps are used. At Rn 700,000, NACA's 64_1-012 airfoil has a C_L max of 0.9 and a minimum coefficient of drag (C_D) of 0.007.

NACA 0012 has C_L max of 1.05 and minimum C_D of 0.0065 at Rn 700,000 and would have been a better choice considering the Rns of these models. However, 64_1-012 was used in the calculations (see Figures 1, 2 and 3).

DRAG

Other important considerations are wing drag, profile drag and particularly induced drag. A model with high wing drag in both level flight and under high G-force will not perform as well as one with lower drag under both. The chart shows some startling comparisons of level flight drag to high-G-force drag.

This study considers only total wing drag; it does not include the drag contributions of fuselage, tail surfaces and landing gear. Although the tail feathers would fray in proportion to each model's wing area, the fuselages would all have the same cross-sectional area and would change only slightly in length; the difference in their contributions to each model's total drag would be minimal.



Model 3. The Canada Goose canard.

COMMENTS

■ **Model 1**—400-square-inch area. The lift coefficient of 0.874 is dangerously close to 64_1-012's C_L max of 0.9. Since this model's level-flight drag is the lowest, it could exceed the 100mph speed, despite its high-G wing drag of 77 ounces, and it could stall at high speed. Its small size would adversely affect its visibility, and its landing speed is high.

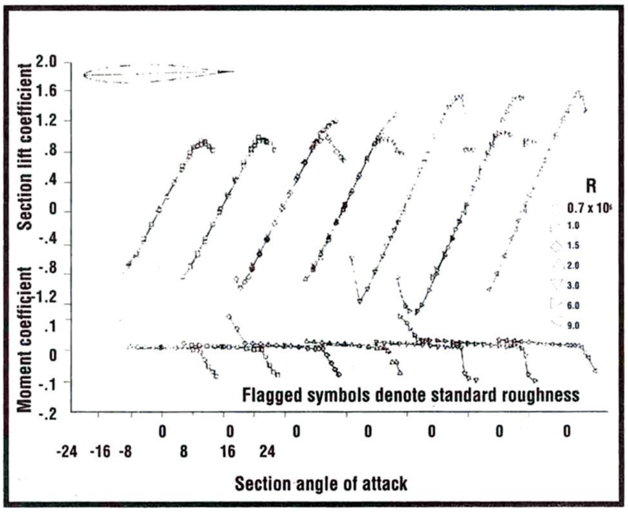


Figure 1. Section lift and pitching-moment characteristics of the plain NACA 64_1-012 airfoil section, 24-inch chord.

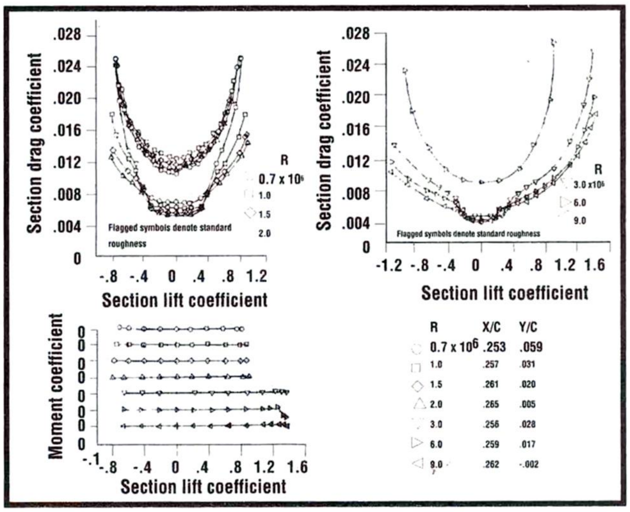


Figure 2. Section drag characteristics and section pitching-moment characteristics about the aerodynamic center of the plain NACA 64_1-012 airfoil section.

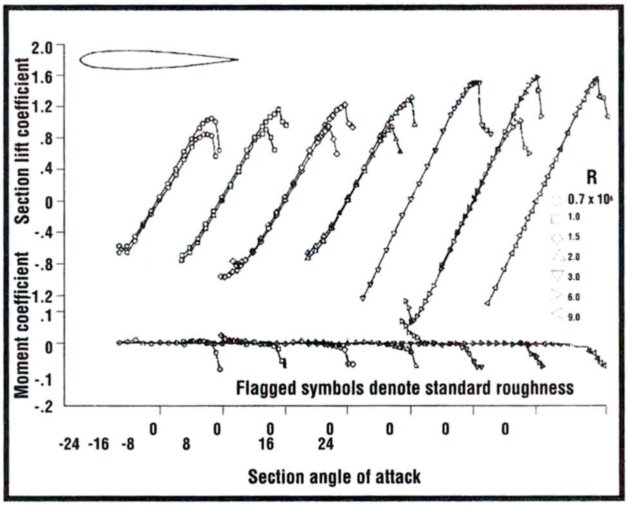


Figure 3. Section lift and pitching-moment characteristics of the plain NACA 0012 airfoil section, 24-inch chord.

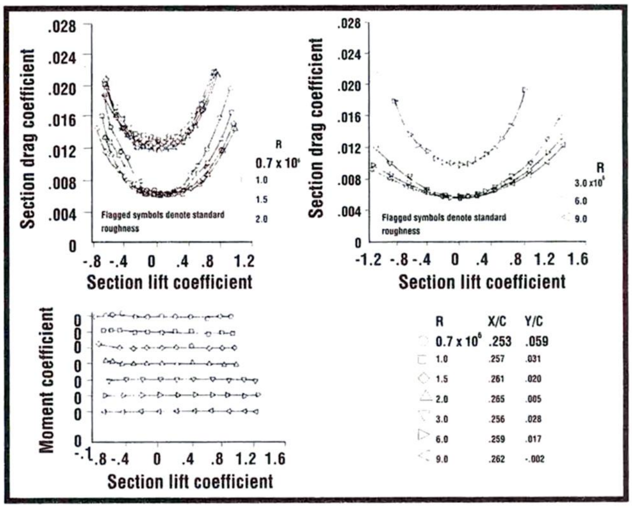
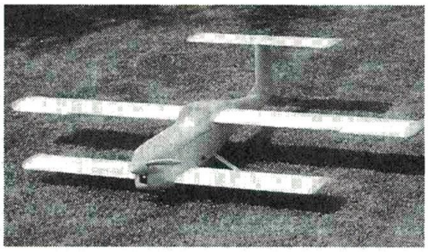
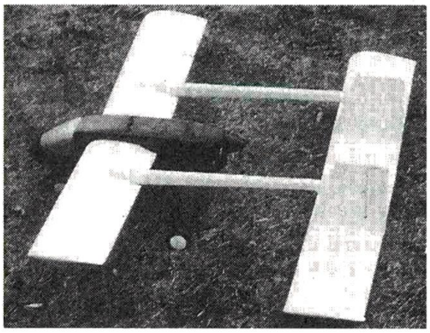


Figure 4. Section drag characteristics and section pitching-moment characteristics about the aerodynamic center of the plain NACA 0012 airfoil section.



Model 5. The Wild Goose three-surface airplane.



Model 2. The Wasp tandem wing.

■ **Model 2**—500-square-inch area. Much the same as for model 1, with the exception that the lower C_L at high Gs of 0.742 compared with the C_L max of 0.9 provides an improved safety margin against high-speed stalls. Landing speed is high.

■ **Model 3**—600-square-inch area, which is the optimum in this author's opinion. At 0.654, its high-G lift coefficient provides a good safety margin. Its level-flight wing drag of 9.7 ounces is good, and its high-G wing drag is reasonable. Landing speed of 29mph is acceptable. Its power loading of 200 ounces per cubic inch displacement proved satisfactory on the Swift, and it is large enough to be readily visible.

■ **Models 4 and 5**—700- and 800-square-inch areas, respectively. Both have the same high-G wing drag; but level flight wing drag increases with the added wing area. Combined with the models' greater weight, this would adversely affect maneuverability. The greater wing area results in lower landing speeds and better visibility.

FORMULAS

In developing this comparison, formulas published in previous articles were used and are repeated below with examples for any fellow designer to follow.

■ **Centrifugal force**

$$\text{G's} = \frac{1 + (1.466 \text{ x max speed})^2}{\text{Turn radius (feet) x } 32.2}$$

At 100mph and turn radius of 60 feet,

$$\frac{1 + (1.466 \text{ x } 100)^2}{60 \text{ x } 32.2} = 12.12 \text{ G's}$$

■ **Lift coefficient needed**

$$C_L = \frac{\text{Gross weight (oz.) x 3519 x G*}}{\text{Speed (mph)}^2 \text{ x Wing area (sq. in.) x K}}$$

At sea level, K is 1.00; at 5,000 feet, 0.8616; and at 100,000 feet, 0.7384.

* If greater than 1G

$$C_L = \frac{92 \text{ x } 3{,}519 \text{ x } 12.12}{100^2 \text{x } 600 \text{ x } 1} = 0.654$$

■ **Wing-drag coefficient**

The profile drag coefficient (C_{Do}) of airfoil 64.012 at a lift coefficient of 0.654 is 0.0155 (see Figure 2).

The total of both profile and induced drags is:

$$C_{Do} + \frac{(0.318 \text{ x Lift } C_L{}^2 \text{x } (1 + \delta^*)}{\text{Aspect ratio}}$$

*δ (delta) is the wing planform correction factor. For a wing of taper ratio 0.6, it is 0.5.

$$\frac{0.0155 + (0.318 \text{ x } .654^2 \text{x } 1.05)}{6} = 0.393$$

■ **Wing drag (ounces)**

Drag (oz.) =

$$\frac{\text{Total wing } C_D \text{ x Speed (mph)}^2 \text{ x Wing area}}{3{,}519}$$

At 12.12 G's,

$$\frac{0.0393 \text{ x } 100^2 \text{ x } 600}{3519} = 67 \text{ oz.}$$

Plug in the numbers, and the formulas may be solved using simple arithmetic. Happy designing!

Micropace Charger/Cycler

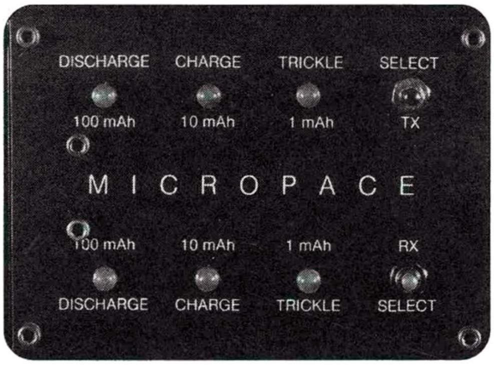
Easy battery maintenance

by ROBERT HOFF

MODEL AIRPLANE NEWS PRODUCT REVIEW

I DID a double-take when I recently saw a Micropace* battery cycler advertised for less than $60. It seemed almost too good to be true. Most cyclers with comparable features cost in the neighborhood of $150, and some with more features cost as much as $200. My curiosity led me to buy and test one.

For those who are new to the R/C game, cycling consists of charging the battery, discharging it to 1.1 volts per cell and measuring the milliamp hours (mAh) delivered during the discharge. If this is done when the battery is new and repeated periodically, battery deterioration will be shown by a reduction in indicated capacity. If cycling is accompanied by measurement of the battery's self-discharge (leakage) rate, deterioration can usually be detected in time to avoid catastrophic failure, possibly during flight.



CAPACITY AND CHARGING

For several reasons, you shouldn't expect the capacity indicated by a cycler to exactly match the advertised capacity. First, some batteries are rated at minimum capacity, and other manufacturers only provide typical capacity. Battery capacity also depends on charge/discharge rates and temperature. Measured capacity tends to be less than is advertised because manufacturers give capacity at a discharge rate that's lower than that imposed by most cyclers. Typically, the discharge rate of cyclers ranges from 200mA to 600mA. To detect battery deterioration, a discharge current reading of anywhere between C/5 and C is satisfactory. For a 600 mAh battery, C = 600mA and C/5 = 120mA.

Battery charging is another matter. The ratings of the kind of batteries that come with most radios and the kind we buy for general use are based on charging at a rate of C/10. For a 600mAh battery, that is 60mA. Most chargers for factory-supplied receiver and transmitter batteries charge at about that rate, because such batteries are usually made up of cells with a capacity of about 600mAh. It's usually OK to charge them at a little less than C/10, but they can not be fully charged with a trickle-charger. The Micropace unit comes in two versions: one has a charge rate of 50 to 120mA, the other, 25 to 50mA. Charging at a higher rate can result in heating and long-term battery damage. Of course, if you buy batteries especially designed for fast charging, the C/10 limitation does not apply.

WHAT TO LOOK FOR

In my opinion, a good basic cycler for modelers who use 4- and 8-cell batteries should charge at about 60mA, stop charging after 14 to 17 hours and automatically switch to trickle-charge at the end of the charge time. It should discharge to 1.1 volts per cell, provide a readout of discharge mAh or time and automatically recharge. Whether or not it will test both receiver and transmitter batteries simultaneously seems to me to be of no particular interest. It should be possible to choose any function (charge, trickle-charge and/or discharge) without going through other functions to get there. If a cycler does not have a charge rate of around 120mA for larger batteries, it can still be used for batteries with a capacity greater than 600mAh by re-initiating the charge cycle and continuing to charge until the voltage measured with an expanded-scale voltmeter (with built-in load) reaches about 1.35 volts per cell. That's the voltage a fully charged cell will show when loaded to between 200 and 300mA.

In addition to the functions discussed above, the Micropace can be programmed with one command to go through two discharge and charge cycles followed by trickle-charge. This feature is not provided by any other cycler that I know of, and it's handy to condition a new battery before putting it into service.

My only complaint: the unit won't cycle the 5-cell receiver batteries used by many modelers.

The Micropace indicates capacity by how many times the various LEDs blink when a button is pressed. The totals are then added. If you lose count for some reason, just push the button again, and it will repeat the process.

HOW TO USE

After you've unpacked the Micropace, remove the front cover and install cables that are compatible with your receiver and transmitter batteries. (You must provide these.) If your transmitter doesn't have a diode in the charging circuit, these cables should have connectors that can be mated with your charging receptacles. If there's a

SPECIFICATIONS

CHARGER/CYCLER

Manufacturer: Micropace

List price: $59.95 (plus S&H)

Warranty: 1 year

Operating power source: AC line

RX/TX battery discharge rates: 300mA (constant current)

RX charge rates: 50 to 120mA; 25 to 50mA (two models)

TX charge rate: 55mA

Cell voltage at end of discharge: 1.1 volts

Features: can discharge, charge and trickle-charge independently; can go through two discharge/charge cycles with one command; automatically switches to trickle-charge after timed charge; can test RX and TX batteries at same time; flashing LEDs indicate capacity.

Comments: a great buy for modelers who fly with the batteries that came with their radios (about 600mAh).

Hits
- Great price.
- Can be programmed with one command to go through two discharge and charge cycles, followed by trickle-charge.
- Good performance for an instrument of this class.

Misses
- Can't cycle the 5-cell RX batteries many modelers use.

diode, you'll have to remove the battery from the transmitter for cycling and provide an appropriate receptacle on the battery. Read your radio's instruction manual carefully.

Because a cycler's most important function is to give a consistent and reasonably accurate read-out of capacity, I started to test the Micropace with the 50 and 120mA receiver charging rates by charging and discharging a 4-cell and an 8-cell Sanyo battery, each rated at 600mAh (minimum) or 650mAh (typical). At the same time, I measured the discharge time of every battery from which I could independently calculate capacity (multiplying the discharge time in hours by the constant discharge current in milliamp hours). The capacities arrived at using both methods were in close agreement.

To complete the evaluation, I compared advertised specifications for charge rate, discharge rate, trickle-charge rate, discharge cutoff voltage, and charge time with the advertised values. Even though my electrical instruments are not highly precise, my measurements generally agreed with advertised values. The low charge rate was between 50 and 63mA, depending on charge status—50mA advertised. The high charge rate was 114mA—120mA advertised. I did not test the model that has charge rates of 50 or 25 mA for receiver batteries.

Measured discharge rates were within 5 percent of the advertised value of 300mA, which is as good as my meter accuracy.

Trickle-charge rates for receiver and transmitter batteries were 13.5 and 6.5mA. That isn't too close to the advertised 10mA, but it's OK for trickle-charging rates.

Discharge cutoff voltages were very close to 1.1 volts per cell as advertised and as commonly defined as the end of a Ni-Cd cell's useful life.

Measured charge times for both 4- and 8-cell batteries were about 15.66 hours—4.4 percent longer than the 15 hours advertised, but not too long to be a problem. If the same time base is used in calculating capacity, the readings of my unit could be 4.4 percent higher, assuming that the discharge current is exactly 300mA. That's good performance for an instrument of this class and price.

The Micropace cycler is a great buy for modelers who fly with the batteries that came with their radios (about 600mAh). Depending on which model you buy, it will also cycle smaller 4-cell receiver batteries in the 270mAh capacity range or larger 4-cell receiver batteries up to 1200mAh capacity.

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

Coming NEXT MONTH

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Lanier RC
33% Extra 300S

Hobby Shack
ARF Tornado

JD Model Products
F-18 Hornet

LDM Industries
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SURVEY

Computer Programs for Modelers

HOW TO'S

- Cover with Fabric
- Make a Field Stand
- Set Wing Incidence

INDEX OF MANUFACTURERS

3W; distributed by Desert Aircraft (see address below).

Ace R/C Inc., 116 W. 19th St., P. O. Box 472, Higginsville, MO 64037-0472; (816) 584-7121; fax (816) 584-7761.

AERO*COMP, P.O. Box 753, Hackettstown, NJ 07840-0753.

Aeronaut; distributed by Hobby Lobby Intl. (see address below).

Aero Scale Products of Switzerland; distributed by Nelson Aricraft (see address below).

Aerotech, 411 Beach Park Blvd., Foster City, CA 94404; (800) 573-9363.

Airtronics, 15311 Barranca Pky., Irvine, CA 92718; (714) 727-1474; fax (714) 727-1962.

AstroFlight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292; (310) 821-6242; fax (310) 822-6637.

Balsa USA, P.O. Box 164, Marinette, WI 54143; (800) 225-7287; fax (906) 863-5878.

Bisson Custom Mufflers, RR 1 Taits Island, Box 32, Parry Sound, Ontario, Canada P2A 2W7; (705) 389-1156; (705) 389-1156.

Bob Banka's Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058.

Brison Aircraft, 12075 Denton Dr., Ste. 11, Dallas, TX 75234; (214) 241-9152; fax (214) 241-5065.

Byron Originals, P.O. Box 279, Ida Grove, IA 51445; (712) 364-3165; fax (712) 364-3901.

Carden Aircraft, 1731 NW Madrid Way, Boca Raton, FL 33432; (407) 367-7744.

Carl Goldberg Models, 4734 W. Chicago Ave., Chicago, IL 60651; (312) 626-9550.

C.B. Tatone Inc., 21658 Cloud Way, Hayward, CA 95249.

Clark Industries, RR4, Totenham, Ontario, Canada LOG 1W0.

Classic Scale, 5 Naseby Rd., Sibbertoft, Market Harborough, Leicestershire LE16 9UG.

Cline & Associates, 807 Alpha Rd., Box 44, Alpha, OH 45301; (513) 426-4167.

Coverite, 420 Babylon Rd., Horsham, PA 19044; (215) 672-6720; fax (215) 672-9801.

Desert Aircraft, P.O. Box 18038, Tucson, AZ 85731; (602) 722-0607; fax (602) 722-0607.

Dremel Tool, 4915 21st St., Racine, WI 53406.

Du-Bro Products, P.O. Box 815, Wauconda, IL 60084; (708) 526-2136; fax (708) 526-1604.

Eagle Aviation, 4573 Lamme Rd., Dayton, OH 45439; (513) 296-1290; fax (513) 296-1290.

F&M Enterprises, 22522 Auburn Dr., El Toro, CA 92630; (714) 583-1455; fax (714) 583-1455.

Futaba Corp. of America, P.O. Box 19767, Irvine, CA 92713-9767; (714) 455-9888.

Gerard Enterprises, W226 N825 Eastmound Dr., Waukesha, WI 53186; (414) 521-0547; fax (414) 521-0551.

Graupner; distributed by Hobby Lobby Intl. (see address below).

Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826-9021; (217) 398-6300; fax (217) 398-1104.

Harry Higley & Sons, Inc., P.O. Box 532, Glenwood, IL 60425; (708) 755-8774.

Hayes; distributed by Carl Goldberg Models, 4734 W. Chicago Ave., Chicago, IL 60651; (312) 626-9550.

Hitec/RCD Inc., 10729 Wheatlands Ave., Ste. C, Santee, CA 92071-2854; (619) 258-4940; fax (619) 449-1002.

Hobbypoxy, 36 Pine St., Rockaway, NJ 07866; (201) 625-3100; fax (201) 625-8303.

Hobby Lobby Intl., 5614 Franklin Pike Cir., Brentwood, TN 37027; (615) 373-1444; fax (615) 377-6948.

Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511

JR Remote Control; distributed by Horizon Hobby Distributors, (see address above).

K&B Mfg., 2100 College Dr., Lake Havasu City, AZ 86403; (520) 855-7901; (520) 855-5930.

Kress Jets, 4308 Ulster Landing, Saugerties, N.Y. 12477; (914) 336-8149; fax (914) 336-5975.

Kruse; distributed by Hobby Lobby (see address above).

Lanier RC, P.O. Box 458, Oakwood, GA 30566; (707) 532-6401; fax (707) 532-2163.

Leisure Electronics, 2950 Airway Bldg. A-4, Costa Mesa, CA 92626; (714) 435-9218.

Master Airscrew; distributed by Windsor Propellor Co., 3219 Monier Cir., Rancho Cordova, CA 95742; (916) 631-8385; fax (916) 631-8386.

McDaniel R/C Inc., 1654 Crofton Blvd., Ste. 4, Crofton, MD 21114; (301) 721-6303; (301) 721-6306.

MFA; distributed by Hobby Lobby (see address above).

Micro Fasteners, 110 Hillcrest Rd., Flemington, NJ 08822; (908) 806-4050; fax (908) 788-2607.

Micropace Inc., P.O. Box 648, Northville, MI 48167; (810) 347-7654.

Miller R/C Products, P.O. Box 425, Kenwood, CA 95452; (707) 833-5905; fax (707) 833-0059.

Modelair-Tech, P.O. Box 12033, Hauppauge, NY 11788-0818; (516) 979-1475.

Model Electronics Corp., 6500 6th Ave. NW, Seattle WA 98117; (206) 782-7458; fax (206) 782-9199.

Moki; distributed by Gerard Enterprises Inc., W226 N825 Eastmound Drive, Waukesha, WI 53186; (414) 521-0547; fax (414) 521-0551.

Nelson Aircraft Co., 21550 N.W. Nicholas Ct., Unit D, Hillsboro, OR 97124; (503) 629-5277; fax (503) 629-5817.

Nick Ziroli Models, 29 Edgar Dr., Smithtown, NY 11787.

O.S.; distributed by Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826-9021; (217) 398-6300; fax (217) 398-1104.

PFM; distributed by Innovative Products, P.O. Box 4365, Margate, FL 33063.

Pica-Robbe Inc., 2655 N.E. 188th St., Miami, FL 33180.

Proctor Enterprises, 25450 N.E. Eilers Rd., Aurora, OR 97002; (503) 678-1300; fax (503) 678-1342.

Robart Mfg., P.O. Box 1247, 625 N. 12th St., St. Charles, IL 60174; (708) 584-7616; fax (708) 584-3712.

Sig Mfg. Co. Inc., 401 S. Front St., Montezuma, IA 50171; (800) 247-5008 (order only); fax (515) 623-3922.

Solartex; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728; (714) 964-0827; fax (714) 962-6452.

Sonic Tronics, 7865 Mill Rd., Elkins Park, PA, 19027; (215) 635-6520; fax (215) 635-4951.

Sullivan Products, P.O. Box 5166, Baltimore, MD 21224; (410) 732-3500; fax (410) 327-7443.

TAGS (Total Aero Graphic Services), 2787 Stage Center Dr., Memphis, TN 38134.

The Aeroplane Works, 2134 Gilbride Rd., Martinsville, NJ 08836; (908) 356-8557.

TNC Electronics and Software, 2 Whites Ln., Woodstock, NY 12498; (914) 679-8549.

Trinity Products, 1901 E. Linden Ave. #8, Linden, NJ 07036; (908) 862-1705; fax (908) 862-6875.

Varsane Products, 546 S. Pacific St., Ste. C-101, San Marcos, CA 92069; (619) 591-4228; fax (619) 591-9211

Webra; distributed by Horizon Hobby Distributors (see address above).

West Systems; distributed by Composite Structure Technology, P.O. Box 642, Tehachapi, CA 93581-0642; (805) 822-4162; (805) 822-4162.

Williams Brothers, 181 Pawnee Street, San Marcos, CA 92069.

Yellow Aircraft, 200 Massachusetts Ave., Lexington, MA 02173; (617) 674-2222; fax (617) 674-2188.

YS; distributed by Futaba Corp. of America (see address above).

Zap Glue, 9420 Santa Anita Ave., Rancho Cucamonga, CA 91730.

Zenoah; distributed by ISC Intl., 10620 N. College Ave., Indianapolis, IN 46280; (317) 844-1978.

Zinger; distributed by J&Z Products, 25029 S. Vermont Ave., Harbor City, CA 90710.

Ziroli; see Nick Ziroli Models.

Zona Tool Company, Box 502, Bethel, CT 06801; (800) 696-3480; fax (800) 299-4208.

Club of the MONTH

Meroke Radio Control Club
c/o 11 Brower Ave.,
Rockville Centre, NY 11570

Established in 1963, the Meroke R/C club—the largest model airplane club on Long Island, NY—has 125 active members who fly at the Nassau County airdrome at Cedar Creek. Members meet twice a month and have building demonstrations, lectures and monthly static judging of new models. They keep busy with fun flys, scale contests and a ½A Texaco event. Social events include an annual family picnic and a dinner dance. The Meroke fliers have also developed a standardized flight-training program that includes manuals for instructors and new-pilot classes in which safety and skills are emphasized. Members can take advantage of the club's video library, which houses more than 50 documentary, flight-technique, building and airshow videos. Future projects include work with the Boy Scouts of America and model demonstrations in schools to introduce children to the hobby.

In the latest edition of "Smoke Signals," the club's monthly newsletter, club president Joe Di Prima encourages members to continue to improve the club. He comments, "It's no different than what we do with our airplanes. Aren't we constantly trying new things with them, trimming, adjusting, modifying, changing, hoping to make them fly better? Don't we love doing that? Let's do the same for our club."

Congratulations, Meroke R/C Club members! Your enthusiasm and support of the model airplane hobby has earned you our "Club of the Month" award. Two complimentary subscriptions to *Model Airplane News* are on their way.

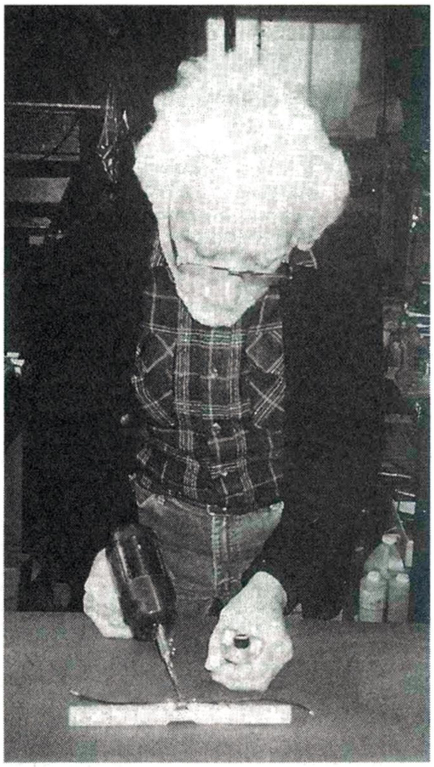
MODEL AIRPLANE NEWS
HOW TO

by JOE BESHAR

I REALIZED that I needed a third (and possibly a fourth!) hand as I attempted to solder a neat, braided, electric wire splice. How do you hold the skinned wire ends together while holding the soldering iron close enough for the solder to melt and solidify into a neat, strong joint? Twisting the wires doesn't work; the ends unravel. How about tinning the wire ends with solder first? This is also frustrating because the wires must be held firmly to apply the solder with adequate heat and prevent the insulation from melting. Having someone else hold the wire doesn't work either because the human nervous system isn't capable of suspending all movement. I've tried using a holding tree with caterpillar-type clips, but I could never get the clips positioned firmly because they don't have enough "pinching power."

Make an inexpensive wire soldering jig

The Third Hand



The author demonstrates the convenience of having a Third Hand.

YOU'LL NEED

THIRD HAND

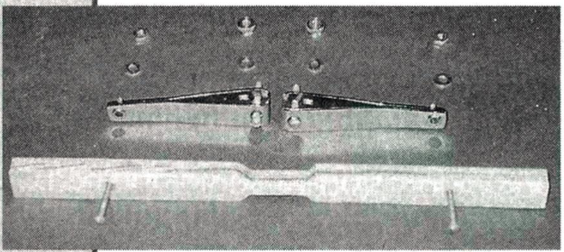
- Two toenail clippers
- Two 6-32, 3/4-inch-long machine screws
- Two 6-32, 1-inch-long machine screws
- Two 6-32 nuts
- Four 6-32 washers
- Two 6-32 knurled terminal nuts
- One 10x3/8x5/8-inch plywood base

MINI THIRD HAND

- Two fingernail clippers
- Four 6-32, 3/4-inch-long machine screws
- Two 6-32 nuts
- Four 6-32 washers
- Two 6-32 knurled terminal nuts
- One 7x3/8x1/2-inch plywood base

A HELPING "HAND"

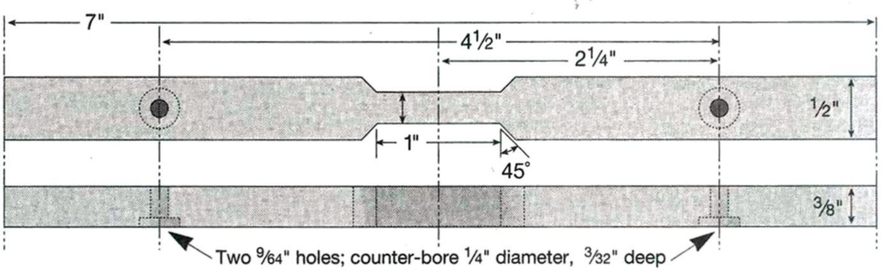
To alleviate these problems, I designed the Third Hand for 12-gauge and thicker wire and the Mini Third Hand for the smaller wires used on radio component leads. I've found the Third Hand essential in wiring electric-powered models and radio components. It allows me to connect and adjust wire lengths to make strong joints, ensure minimum electrical resistance and apply heat-shrink tubing easily. The cost of building the Third Hand and Mini Third Hand is nominal. I paid less than $4 for two toenail clippers and $3 for two fingernail clippers.



All the parts are in position and ready for assembly.

To make your own Third Hand, remove the pin that holds the arm to the clipper, and discard the pin and arm. Cut the base as shown in Figure 1 then, using the photo at left as a guide, assemble the parts.

Solder the heads of the 3/4-inch-long,



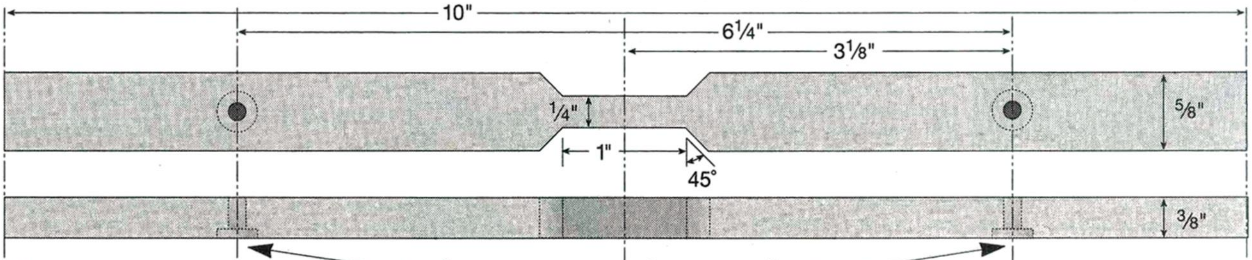
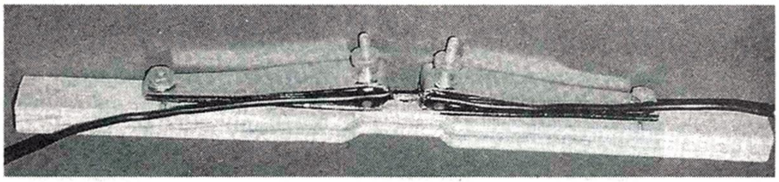
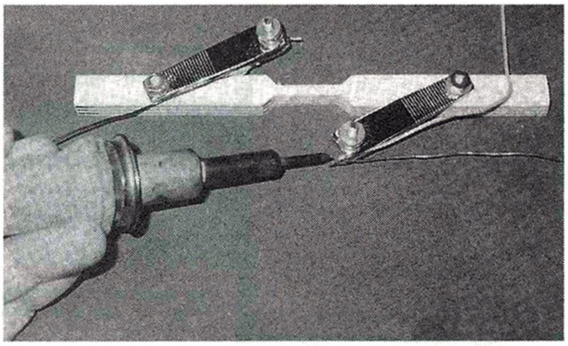


Figure 1



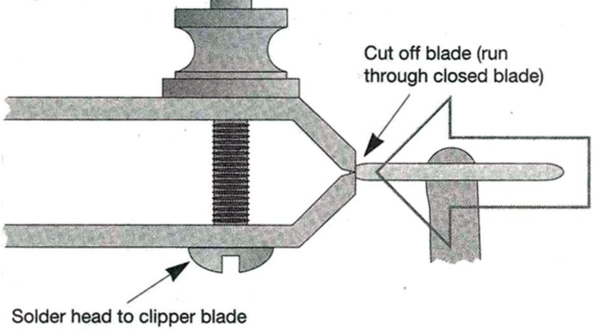
The arms hold the wires firmly in position for soldering.



The moveable clipper holds the stripped wire ends away from the Third Hand's base while they are being tinned.

6-32 screws to the bottom clipper blades in each side of the Hand. Then turn the knurled nut until the sharp edges of each clipper touch. Run a cutoff wheel mounted in a Dremel* tool between the blade edges to dull them (see Figure 2). Now your Third Hand is ready to use.

Figure 2



SOLDERING

Strip the wire ends as desired, and string heat-shrink tubing along the wires and away from the stripped ends. For stability, clamp the Third Hand into a vise or onto a table. Clamp the stripped wire ends firmly in the clipper "throats" by turning the knurled nuts. Swing the clamped wire ends out from the base, and tin them with solder. Return both clamped wires into position, placing the tinned ends against one another (squeeze them together with pliers). Solder the joint. Presto! You have a strong, reliable, soldered joint. Remove the soldered splice by unscrewing the knurled nuts. Slide the heat-shrink tubing over the splice, and shrink it with a heat gun.

Making a strong, neat connection is easy with the Third Hand. Try it!

**Addresses are listed alphabetically in the Index of Manufacturers on page 110.*

About the author
Joe Beshar has been building and competing with model airplanes for 60 years and has written more than 22 articles, including many helpful how-to features. He has served as president of the Society of Antique Modelers and as a vice president of the AMA. Joe lives in Oradell, NJ.

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NEW ZEALAND AERO PRODUCTS. Scale plans: Rearwin Sportster, Hall's Springfield Bulldog, Typhoon, Pawnee, Airtruk/Skyfarmer, Agwagon, Pawnee Brave, Fletcher FU-24, DC-3/C-47, Fairchild PT-19, Fleet PT-26, Cessna Aerobat, and more. Hardware Paks, color photo paks available. Free documentation with plans. Catalogue/Price list: $5 (U.S.); Visa/MC. 34 *Ward Parade, Stirling Point,* Bluff, New Zealand. Phone/24-hr. fax 0064-03-212-8192. [2/97]

MODEL WARPLANES, 1996: over 10,000 plans, kits, photos, 3-views listed. Send SASE to John Fredriksen, 461 Loring, Salem, MA 01970 (508) 745-9849. [10/96]

PLYWOOD—Aircraft quality Finland Birch. Call for free price list: (800) 222-7853. [2/97]

SCALE AIRCRAFT DOCUMENTATION and Resource Guide. Larger, updated 1996 edition. World's largest commercial collec*tion. Over 5,800 different color FOTO-*PAAKS and 33,000 three-view line drawings. 188-page resource guide/cata*logue—$8; Canada-$10; foreign-$15.* Bob Banka's Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058. [2/97]

R/C WARBIRDS ON VIDEO. Warbirds 95, Birds of Prey 95, Jumbo Jamboree 95, $19.95 each plus $3 S&H. A.M.R. Productions, P.O. Box 1813, Toms River, NJ 08754. [10/96]

SODA-CAN AIRPLANES—replica biplane detail plans with photos $7.50 PPD, Early's Craft, 15069 Valley Blvd. SP 26, Fontana, CA 92335. [8/97]

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ANTIQUE IGNITION engine parts: excellent reproductions, fuel tanks, points, timers, coils, needle valves, gaskets, etc. Champion spark plugs. Catalogue—$6 (intl. airmail—$8). Aero-Electric, 3706 North 33rd, Galesburg, MI 49053; (616) 665-9693. [10/96]

PLANS ACCURATELY ENLARGED or copied. Any scale, any size. Money-back *guarantee. Send $2 for info and a cus*tomized poster for your shop. Roland Friestad, 2211M 155th St., Cameron, IL 61423. [12/96]

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MIXERS & RETRACT CONTROLLERS! MicroMixer for flaperons, elevons, V-tails, flying wings! MicroRetracts sequences 3 servos in slow motion from one channel! These are tiny ⅓-ounce airborne computer controllers for standard radios! Without connectors, $29 each plus $2.25 shipping, Quillen Engineering, 561 N. 750 W., Hobart, IN 46342 (219) 759-5298. [10/96]

LARGE-SCALE SAILPLANES AND TOWPLANES—*new and used—call* (212) 879-1634, Sailplanes Unlimited, 63 East 82nd St., New York, NY 10028. [11/96]

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***SAITO* ENGINE REPAIRS:** Now available at A-Train Hobby by the Oldtimer. Other gas engine repairs also available. A-Train Hobby, 13503B Southeast Mill Plain Blvd., Vancouver, WA 98684; (360) 944-5403. [12/96]

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R/C PHOTO CLASSIFIEDS—A photo advertisement magazine of new and used radio-control equipment. Advertise your product with an Individual Advertisement space in 2 issues for only $23. Subscription is only $48 for 12 issues and the magazine issues once every month. Hobbyists everywhere are looking for new and used equipment, and the R/C Photo Classifieds is the place to find them. Send Email to RCPHOTO-CLS@AOL.COM (818) 417-8737. [11/96]

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WANTED: ignition model engines 1930s to 1950s, especially Elf, Baby Cyclone, Brown Jr., Ohlsson Custom and Gold Seal. Also model racecars, any parts, spark plugs, etc; Woody Bartelt, 3706 North 33rd, Galesburg, MI 49053; (616) 665-9693, or (800) 982-5464. [10/96]

CASH FOR ENGINES: ignition, glow, diesel–all types; any condition; sale list, too! Estates my specialty! Send SASE for list. Bob Boumstein, 10970 Marcy Plaza, Omaha, NE 68154; (402) 334-0122. [8/96]

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MODEL MOTORS WANTED: most types, 1970 and earlier. Cash or trade. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [12/96]

WANTED: Cox, Wen-Mac, Testors, etc. Gas-powered plastic cars, planes, boats. Please call or write. Dean Barham, 4032 Iowa St., San Diego, CA 92104; (619) 528-1680. [10/96]

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WANTED COX BOATS: Water Wizard, See Bee. Hydro-Blaster. Dean, 4032 Iowa St., San Diego, CA 92104. [12/96]

EVENTS

FUN FLY & TAILGATE SWAP MEET—Roanoke Valley RC, Sept. 21, 9 - 5 p.m., Sept. 22, noon - 5 p.m. At the field S. McClelland St., Salem, VA. AMA-sanctioned event. All channels available. CD-Marshall McCluny. Landing or vendor fee $5. Frequencies monitored. Transmitters impounded. 98db enforced. Nearby motels and campsites. Concessions. No flying before noon on Sunday. Information, call (540) 387-3497. [9/96]

CORONA, CA, Main Event Indoor Train, Model & Collectible Swap Meet. 2180 Nevada (south McKinley, off 91 fwy) August 23-25. Friday 5 p.m.-10 p.m. Sat/Sun 10 a.m.-5 p.m. Free Admission. (909) 371-4451. [9/96]

RATES: non-commercial—25 cents per word (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.** To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. Please make all checks payable to: **AIR AGE, INC. SEND AD AND PAYMENT TO: Elise Silkowski, CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035, or call (203) 834-2339.**

Product NEWS

LATEST PRODUCT RELEASES

22ND CENTURY AERO PRODUCTS

Advanced Aero Fueler

New from 22nd Century Aero Products, this Advanced Aero Fueler should be in every tote box. Its airtight seal prevents fuel from being contaminated by moisture and dirt, and there's no worry about accidental spills. The system includes 5 feet of scientific-grade coiled tubing (enough to hook up the fuel probe and pump), TwistKonexx™ quick-lock fittings, a locking cap, a drilling template and all the fittings needed for assembly.

Price—$14.95.

Horizon Hobby Distributors; (217) 355-9511, or order directly from **22nd Century Aero Products**, 2763 West Ave. L, Ste. 295, Lancaster, CA 93536; (805) 943-5394.

PACER TECHNOLOGIES

Hinge Glue

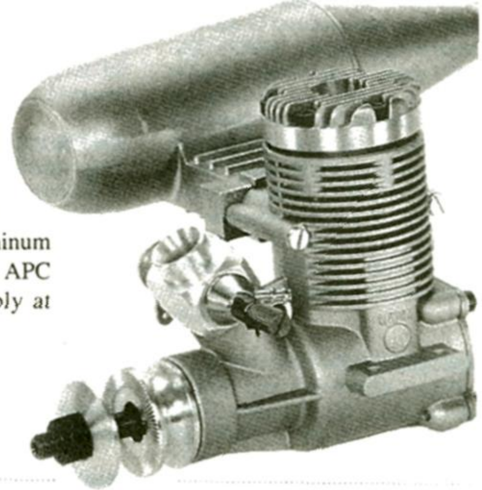
This new adhesive will glue any hinge to any material quickly and easily. It dries to form a flexible bond in approximately 30 minutes.

Part no.—PT-55 (1 oz. bottle); **price**—$2.99.

Pacer Technologies, distributed by FTE, 15300 Estancia Ln., West Palm Beach, FL 33414; (407) 795-6600; fax (407) 795-6677.

WEBRA

Speed .40 Sport Engine



Featuring a diamond-cut head and bead-blasted finish, the Speed .40 has a dual-ball-bearing-supported crankshaft, aluminum piston and ABC construction. A Webra TNII carb has O-ring seals on the high-speed needle and aluminum throttle arm. The Speed .40 can swing an APC 10x6 prop at 14,200rpm and idle reliably at 2,100rpm.

Part no.—WEBE412; **price**—$139.95.

Webra; *distributed by Horizon Hobby* Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

VAILLY AVIATION

P-47 Thunderbolt

This updated Roy Vaillancourt design features reworked, redrawn plans that include bubble and razorback cockpit variants, full-size formers and the complete wing structure. Wood kits are also available, as are many accessory parts, such as a fiberglass cowl, optional fiberglass fuselage, clear plastic canopy (bubble or razorback), wheels and pilots. Specifications: wingspan—92 inches; length—78 inches; engine required—3.2 to 4.2ci. Send $1 to Vailly Aviation for a complete catalogue.

Vailly Aviation, 18 Oakdale Ave., Farmingville, NY 11738-2828; (516) 732-4715 (after 7 p.m. EST).

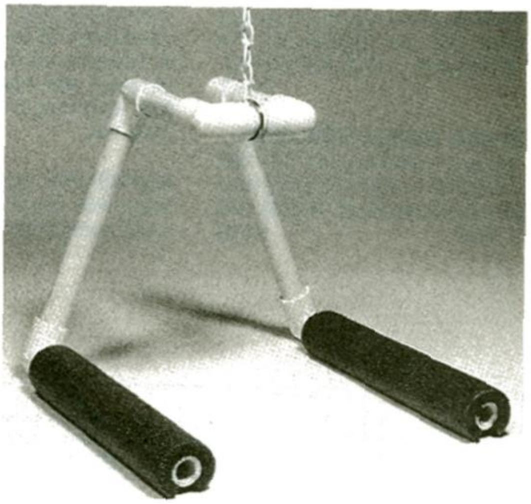
AIRWAVES PRODUCTS

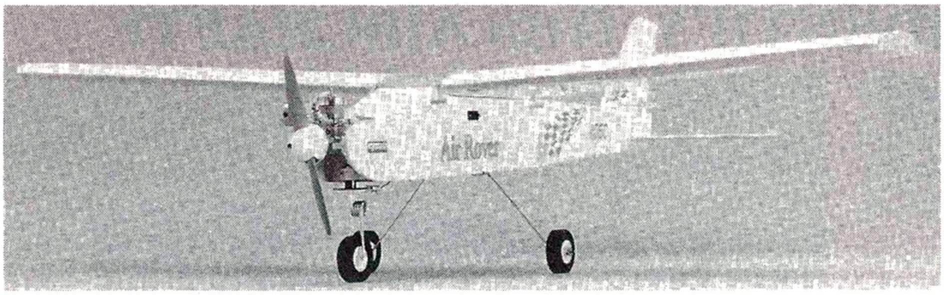
The Airplane Hangar

This handy device will help you to store your models safely. Hang the Airplane Hangar from the ceiling, then slide your model into the foam-covered supports. You can route your charging cables from the ceiling so that the models are always ready to go to the field. No assembly is required, and all necessary hardware is included. The Airplane Hangar can cradle planes of up to 15 pounds and works well with most designs.

Price—*$8.95 plus S&H.*

AirWaves Products, 12611 Thunder Chase, Herndon, VA 22071; (703) 736-9321.





KYOSHO

Air Rover™ 10 Trainer

This ARF model has an all-wood fuselage and a joined, wood-planked foam wing. It comes with a complete hardware package that includes a fuel tank, linkages, an engine mount, landing gear and wheels. The Air Rover™ features a Clark Y airfoil with dihedral for maximum stability. Specifications: wingspan—41.7 inches; length—35.8 inches; weight—2.4 pounds; engine required—.09 to .15 2-stroke; radio required—4-channel with three servos.

Part no.—KYOA1250; **price**—$139.99.

Kyosho; distributed by Great Planes Model Distributors, 2904 Research Rd., Champaign, IL 61826-9021; (217) 398-6300; fax (217) 398-0008.

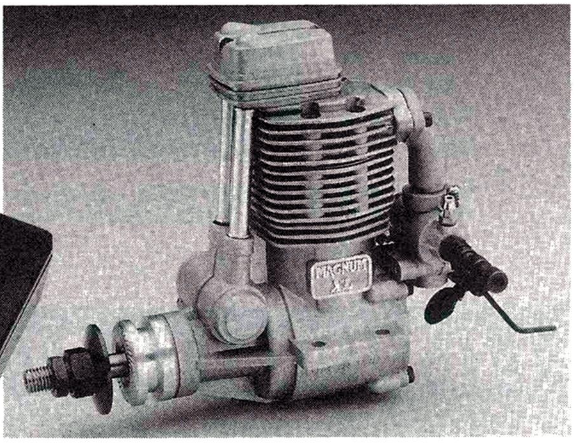
MAGNUM

XL-91RFS

This new 4-stroke engine has an aluminum alloy piston with an iron ring that runs inside a steel sleeve for optimum compression, performance and longevity. Two machined, overhead poppet valves are actuated by rocker arms and pushrods that are driven by a cam above the crankshaft. The XL-91RFS also has a two-needle-valve carburetor that's easy to adjust and a needle-valve extension.

Part no.—210970; **price**—$359.95.

Magnum; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133; fax (714) 962-6452.

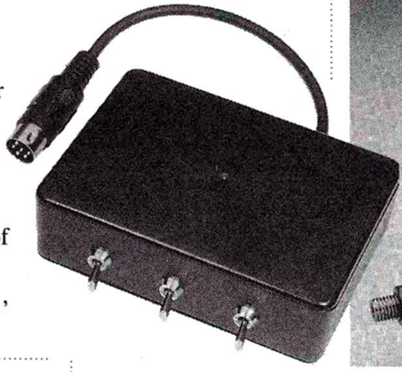


DSS PRODUCTS

Channel Extender

Extend the channel capabilities of your Futaba Conquest digital proportional radio with this device. Made of ABS plastic, it features three non-proportional control channels and is frequency-independent. You can transfer the Extender between any of your Conquest systems quickly and easily.

DSS Products, 415 Knoch Knolls Rd., Naperville, IL 60565; (708) 983-5755.



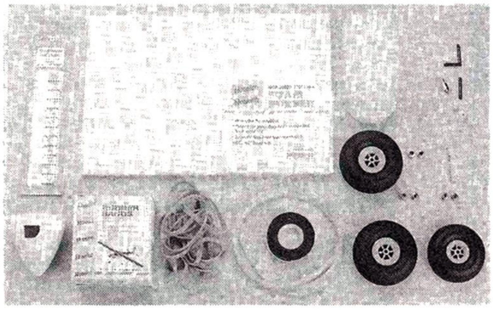
GREAT PLANES

PT-Series Completer Pack

Building a Great Planes Perfect Trainer couldn't be easier with this hardware and accessories package. Each includes a prop, wheels, fuel tank, wheel collars, rubber bands, tubing, lead weights and more. You need buy only glue, filler, epoxy and covering.

Part nos.—GPMQ2500 (PT-20 pack), GPMQ2502 (PT-40), GPMQ2504 (PT-60); **prices**—$26.99, $27.99, $29.99.

Great Planes Model Distributors, 2904 Research Rd., Champaign, IL 61826-9021; (217) 398-6300; fax (217) 398-0008.



GLOBAL QUALITY KITS

Beaver 40

This DeHavilland DHC-2 Beaver kit features machine- and die-cut balsa and balsa plywood parts with self-jigging, tab-and-slot construction. A fiberglass cowl, shaped landing gear, an injection-molded engine mount and all clevises and horns are included, as are full-size plans and a photo-illustrated construction manual. Specifications: wingspan—64 inches; wing area—480 square inches; engine required—.40 to .53 2-stroke; radio required—5-channel.

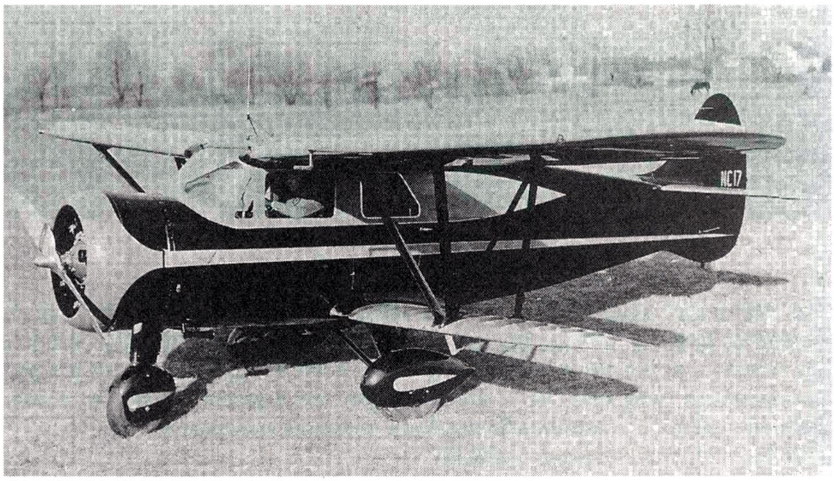
Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133; fax (714) 962-6452.

Descriptions of products appearing in these pages were derived from press releases supplied by their manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, nor does it guarantee product performance. When writing to the manufacturer about any product described here, be sure to mention that you read about it in **Model Airplane News**. **Manufacturers!** To have your products featured here, address the press releases to **Model Airplane News,** attention: Product News, 251 Danbury Rd., Wilton, CT 06897-3035.

Name THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If you can, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897-3035.



Congratulations to George Cooke of Inglewood, CA, for correctly identifying our June mystery plane. At a cost of approximately $75,000, the Bellanca 28-92 trimotor monoplane was built in 1937 for Capt. Papano—a Romanian stunt pilot. With it, he attempted—unsuccessfully—to set a long-distance speed record between New York and Romania. The airplane also raced in, but didn't finish, the 1938 Bendix Air Race, and in 1939, it placed second in that event. Powered by a nose-mounted Fairchild 420hp Ranger and two wing-mounted 250hp Menasco C-65A engines, its range was 4,000 miles at a cruising speed of 240mph, and its top speed was 285mph at 12,000 feet.

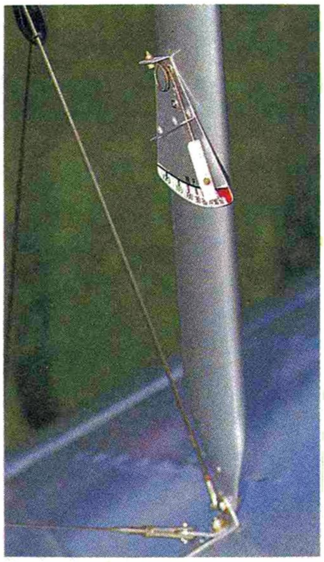
The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to *Model Airplane News*. If already a subscriber, the winner will receive a free one-year extension of his subscription.

ADVERTISER INDEX

FLYING THE TIGER MOTH

The winning model in Team Scale at this year's Top Gun Scale Invitational was a superbly executed 31-percent-scale de Havilland D.H.82A Tiger Moth built by Graeme Mears of Toronto, Canada. Graeme also won the Best Biplane and Best Foreign Entry awards. Graeme's Tiger Moth is an exact duplicate of G-ABXZ—the last full-size Tiger Moth to be rebuilt in England at the Fairoaks aircraft facility.

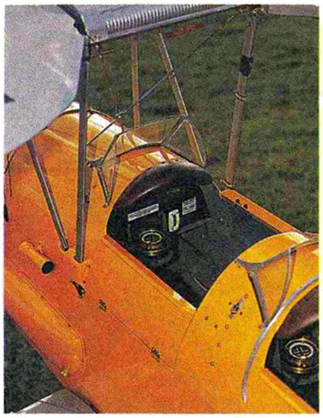
Besides the builder half of the team, you need a great pilot to fly the plane and help win the award. Dave Patrick, another well-known Canadian modeler and author of our "Aerobatics Made Easy" column, flew the Tiger Moth in true scale-like fashion. For his flying efforts, Dave won the Realistic Flight award.



A mechanical airspeed indicator mounted on the wing strut.

Pilot Dave Patrick (left) and Graeme Mears—first-place winners in the '96 Top Gun Team Scale category.

Dave mentioned that taking off required a sufficient amount of right rudder for tracking straight down the runway. A dive for speed on loop entry was necessary along with some added right rudder to keep the plane tracking straight in the climb. Toward the top of the loop, the power was cut, and the elevator was relaxed a little to provide a scale-like round loop. A barrel roll was completed with the help of the rudder. Snap-rolls and spins needed a moderate amount of opposite control to stop their revolutions.



The cockpit is fully detailed with instrumentation, switches and placards.

Overall, the rudder was sensitive and powerful and helped tremendously in the crosswind takeoffs and landings. The bottom wing ailerons proved very effective, but additional elevator throw was needed.

Partial power was definitely needed for landings. Dave tried gliding the Tiger Moth on the approach, but the sink rate just wouldn't allow it. During the third round, Graeme's five-year-old Moki engine blew a cylinder, and Dave had to use full power to land the plane. It must have been a heart-stopping moment. All in all, an excellent effort from the two gentlemen from the north, and we at *Model Airplane News* congratulate them on their win.

—Gerry Yarrish

SPECIFICATIONS

Wingspan: 111 in.

Length: 90 in.

Wing area: 3,500 sq. in. (approx.)

Weight: 35 lb.

Propeller: Clark Industries 24x8

Engine: Moki* 3.6 twin-cylinder 2-stroke glow

Power: 7.8hp

Max. rpm: 7,000

• Wings and stabilizer

Construction: spruce spars, balsa ribs and aluminum tube tips

Covering: SuperShrink Coverite*

Stitching: no. 4 waxed whipping thread (400 ft. approx.)

Surface tape: Stits ½, ¾ and 1 in. wide

Finish: one coat Rand-O-Proof, clear butyrate, Endura FC primer, silver dope and clear Standox

• Fuselage

Construction: spruce longerons and aircraft plywood

Covering: SuperShrink Coverite

Finish: one coat Rand-O-Proof, clear butyrate, Endura FC primer and Endura top coat

• Suppliers

Fasteners (1,000+): Micro Fasteners*, Nelson Aircraft*

Paint: Randolph, Endura, Hobbypoxy*, K&B Super Poxy*

Engine: Gerard Enterprises*

Adhesives: Zap*, Balsarite, West Systems*, PFM*

Turnbuckles: Proctor*

Surface tapes: Scale Stits, F&M Enterprises*

Servos/receiver: Futaba*

Covering: Coverite

Glow driver: McDaniel R/C*

Scale prop: Clark Industries*

Fuel system: Cline Saito

Muffler: Bisson*

Flying wires: Aero Scale Products* of Switzerland

Plans by Frederick Beard; kit by Classic Scale*

Building time: 1,500 hrs.